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# DEPARTMENT OF THE AIR FORCE

## SUPPORTING DATA FOR AMENDED FISCAL YEAR 1988/89 BIENNIAL BUDGET ESTIMATES

SUBMITTED TO CONGRESS FEBRUARY 1988



# DESCRIPTIVE SUMMARIES

**RESEARCH, DEVELOPMENT, TEST AND EVALUATION**

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF
THE DEPARTMENT OF THE AIR FORCE RESEARCH AND DEVELOPMENT PROGRAM
AMENDED FY 1988/1989 BIENNIAL BUDGET
FEBRUARY 1988

## INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) General. This document has been prepared to provide information on the United States Air Force ~~(USAF)~~ Research, Development, Test and Evaluation ~~(RDT&E)~~ Program to Congressional Committees during the Fiscal Year 1989 hearings. This information is in addition to the testimony given by DOD witnesses.

(U) The Descriptive Summaries provide narrative information on all RDT&E program elements and projects, except those listed in paragraph 4b, within the USAF FY 1989 RDT&E Program. A Test and Evaluation section is provided for major weapon systems. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional Committees insofar as possible.

(U) The "RESOURCES" portion of the Descriptive Summaries includes, in addition to RDT&E funds, procurement funds and quantities, Military Construction Appropriation funds on specific development programs, Operation and Maintenance Appropriation funds where they are essential to the development effort described, and, where appropriate, Department of Energy (DOE) costs.

(U) Pages 891-899 are in response to the Senate Appropriations Committee requirement contained on page 78 of the Senate Appropriations Committee report (98-292, 1 November 1983).

(U) The section of the Amended Fiscal Year 1988/1989 Biennial Budget Descriptive Summaries entitled "Facilities Exhibits" (pages 905-915) contains information on major improvements to and construction of government owned facilities funded by RDT&E.

2. (U) Comparison of Fiscal Year 1987, 1988, and 1989 Data. A direct comparison of Fiscal Years 1987, 1988, and 1989 data shown in this document with corresponding data in the Program Element Descriptive Summaries dated January 1987 will reveal significant differences. Many of the differences are attributable to the following factors:

a. (U) Fiscal Year 1988 reductions as a result of Congressional action on the appropriation.

b. (U) Fiscal Year 1987 funding changes between 1 October 1986 and 30 September 1987 due to RDT&E Reprogramming Actions.



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c. (U) Reclassification of Fiscal Year 1987 and Fiscal Year 1988 data to achieve comparability with the program structure for Fiscal Year 1989.

3. (U) Relationship of Amended Fiscal Year 1989 Budget Structure to the Fiscal Year 1988 Budget Approved by the Congress.

| PROGRAM ELEMENT | REMARKS |
| --- | --- |
| BUDGET ACTIVITY 1: TECHNOLOGY BASE | |
| None | |
| BUDGET ACTIVITY 2: ADVANCED TECHNOLOGY DEVELOPMENT | |
| 0603270F Electronic Warfare Technology | New program element for efforts previously contained in Program Element 0603743F. |
| BUDGET ACTIVITY 3: STRATEGIC PROGRAMS | |
| 0101313F War Planning ADP - SAC | New program element for efforts previously contained in numerous program elements. |
| 0603265F Conventional Long Range Cruise Missile | New program proposed for FY 1989. |
| 0604326F Strategic/Conventional Standoff Capability | Funds were not requested in original FY 1988/89 President's Budget. FY 1988 Appropriations Bill contained funds for HAVE NAP. |
| BUDGET ACTIVITY 4: TACTICAL PROGRAMS | |
| 0604233F Tanker, Transport, Training System | New program proposed for FY 1989. |
| 0604270F Electronic Warfare Development | New program element for efforts previously contained in numerous Electronic Warfare program elements |
| 1110011F Force Enhancements - Active | New program element for efforts previously contained in Program Elements 0404011F, 0603256F, 0604219F, 0401840F. |



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BUDGET ACTIVITY 5: INTELLIGENCE & COMMUNICATIONS

None

BUDGET ACTIVITY 6: DEFENSE-WIDE MISSION SUPPORT

None

Pages 192 and 248 are classified and were left blank intentionally.
Per Mr. Jean Lefleur, USAF/RDXR







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## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0601101F
DOD Mission Area: 510 - Defense Research

Title: In-House Laboratory Independent Research
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 14,998 | 15,653 | 10,223 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program provides discretionary funds to Air Force Laboratory Directors to use in pursuing promising high technical risk, high potential payoff opportunities which arise during the budget year. This program allows the Air Force Laboratories to maintain an aggressive research program critical to their existence and their role as leaders of national research. This program is especially important in light of the increasing challenge to maintain technological superiority over potential adversaries. The Office of the Assistant Secretary of the Air Force for Acquisition determines the distribution of funds to the thirteen participating Laboratories based on reviews of the previous fiscal year efforts.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 15,125 | 15,653 | 16,733 | Continuing | N/A |

EXPLANATION: (U) The FY 1989 difference is part of an overall Air Force RDT&E budget reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Investigations funded by this program are an important and integral part of the total Science and Technology programs of the Air Force Laboratories. Results from this Program Element are transitioned to the other research and development activities of the Laboratories for continued funding. The Army and Navy have similar programs. Oversight responsibility for these programs is in the Office of the Deputy Under Secretary of Defense (Research and Advanced Technology).

6. (U) WORK PERFORMED BY: Numerous small contracts are awarded to universities and industrial laboratories each year, in addition to work units performed within the Air Force Laboratories. The five major contractors during FY 1987 were: Systems Research Laboratory, Dayton, Ohio; University of Utah, Salt Lake City, Utah; University of Florida, Gainesville, Florida; University of Dayton, Dayton, Ohio; and University of Lowell, Lowell, Massachusetts. There were 121 additional contractors doing work under 149 contracts at a total dollar value of $11.0 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0601101F, In-House Laboratory Independent Research

A. (U) Project Description: The purpose of this program is to provide discretionary authority to Laboratory Directors of the Air Force Systems Command to fund technology efforts judged to be of high promise or importance. The Air Force has set up and administered this program in strict compliance with the intent that it would be unencumbered by restrictive reviews and procedures, or justification and documentation prior to beginning work. Laboratory Directors meet annually with the Assistant Secretary of the Air Force for Acquisition to report their achievements and the status of their projects.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The following is a sampling of noteworthy efforts. They were selected to demonstrate the scope of the program, and should not be viewed as an exhaustive list in any one research area.

a. (U) The feasibility of converting electromagnetic waves into electricity using antennas as receptors rather than solid-state devices has been demonstrated. Antenna technology offers a highly efficient alternate energy source, theoretically at least twice that of conventional solar converters, for airbase and for remote site survivable power. The experimental results obtain from this investigation have been used to refine antenna theory for wide-band performance and to define antenna configuration and material requirements. This effort has been transitioned to the exploratory development (6.2) program.

b. (U) A unique optical phase conjugation system has been designed in which a phase conjugate mirror is pumped by two independent, same wavelength lasers that act both as pumps and probes. The purpose of this work is to enhance laser communications between aircraft by eliminating the signal fading caused by atmospheric distortions along the signal path. This concept for correcting optical wavefronts has been effectively demonstrated and a development phase has begun for the propose of determining the level of crosstalk which may occur, effective optical pump power, and modulation speed limits imposed by the design.

c. (U) Human Systems Division investigators continue to search for ways to deal with gravity-induced loss of consciousness. The purpose is not only to save lives and aircraft, but also to permit future aircrews to fly the entire flight envelopes provided by advances in aeronautical engineering. Three efforts were undertaken in FY 1987. (1) Straining maneuvers performed by aircrew subjects permit greatly increased tolerance to gravitational effects. Further enhancement is being demonstrated by adding isometric contractions of certain isolated muscle groups such as jaw, leg, and forearm. The result is sustained blood pressure increases which combat loss of consciousness. (2) Techniques, such as physiological stimulation, are showing results in reducing the total incapacitation period of pilots suffering gravity-induced loss of consciousness. (3) A fluid-filled anti-gravity suit has been investigated

which permits differential pressures in separated parts of the suit. In combination with an earlier accomplishment from this program - an electrocardiogram driven hydraulic controller - significant increase in the loss of consciousness threshold will result.

d. (U) Directed energy devices have been investigated and developed for long range, strategic deployment. Research under this program now undertakes application of directed energy against a variety of air and ground, short range, tactical targets. The physics of coupling the energy released in high explosives to the electromagnetic fields used to accelerate a directed beam of charged particles has been demonstrated. In addition, the first iteration of hardware fabrication and testing has been completed. Upon completion of a final phase of diagnostic experimentation, this effort will be transitioned to the exploratory development (6.2) program.

e. (U) A feasibility investigation of a two-stage rocket combustion concept has been concluded with very positive results. The new concept is based on reaction between small molten aluminum drops generated in one stage and water injected into the second. It is estimated that this rocket booster system would reduce fuel and oxidizer costs by well over 50 percent. In addition, there is no toxic exhaust to deal with, and handling costs and complexities are greatly reduced. Propellant scale-up and hardware fabrication have been completed, and demonstration firings are scheduled for FY 1988.

f. (U) Assessing the survivability of ground-based assets requires accurate predictions of the response of natural materials to the high stresses created by explosive weapon detonations. A linear viscoelastic model has been developed and experimentally verified which has significantly improved our understanding of ground shock physics in unconsolidated and non-homogeneous alluvial material deposits. This linear technique is much less expensive than finite difference codes, and provides improved acceleration calculations in highly attenuative environments. The technique has been transitioned to a Defense Nuclear Agency exploratory development (6.2) effort.

g. (U) Fighter pilots performing missions in multi-threat environments will obtain expert assistance as a result of research performed to develop algorithms which will alert the pilot of missile attack and assist in evasive maneuvers. The algorithms can not only drive displays to provide pilot cues, but also drive a control coupler for automatic maneuver execution, deploy counter missile devices. The final phase of this project will include evaluation by operational aircrews in combat simulation.

h. (U) One severe limitation imposed on the performance of advanced turbine engines is turbine blade heating. Previous research led to the development of new materials which resist the deleterious effects of heat. In this effort, a new design procedure has been developed to reduce blade heating. The procedure which includes heat flux predictions is being used to design optimized heat transfer airfoils; that is turbine blades with specified aero-dynamic characteristics. The objective is to reduce turbine blade heat by as much as fifty percent. One design result is to inscribe very small grooves on the surfaces of the blades in the direction of flow. This and other design candidates will undergo bench scale tests prior to exploratory development transition.

i. (U) Material alternatives to mercury cadium telluride (HgCdTe) for use in long wavelength infrared

radiation detectors are being sought. The objective is to overcome the severe producibility and uniformity problems of HgCdTe. A superlattice composed of mercury telluride (HgTe) and cadmium telluride (CdTe), in which the HgTe/CdTe ratio is approximately two, has been demonstrataed to have a gap wavelength uniformity an order of magnitude better than HgCdTe in the long wavelength band. This superlattice material grown on gallium arsenide exhibits excellent crystal quality and producibility. The concluding phase of this research has determined the structural parameters, calculated energies (which agree with optical data), fully characterized the material properties, and documented the results in a Technical Report.

(2) (U) FY 1988 Program: The distribution of $15.7 million was approved by the Assistant Secretary of the Air Force for Acquisition. Efforts begun in FY 1987 will be continued; the Laboratory Directors will select new efforts of high promise to be supported during the remainder of 1988.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program in FY 1989 will continue as in FY 1988. New efforts will not be selected until FY 1989.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0601102F
DOD Mission Area: 510 - Defense Research

Title: Defense Research Sciences
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 197,619 | 182,748 | 189,444 | Continuing | N/A |
| 2301 | Physics | 19,609 | 21,148 | 20,136 | Continuing | N/A |
| 2302 | Structures | 11,923 | 10,662 | 11,718 | Continuing | N/A |
| 2303 | Chemistry | 22,660 | 23,744 | 25,407 | Continuing | N/A |
| 2304 | Mathematics | 21,160 | 21,084 | 21,729 | Continuing | N/A |
| 2305 | Electronics | 21,687 | 20,467 | 21,859 | Continuing | N/A |
| 2306 | Materials | 23,095 | 23,179 | 24,109 | Continuing | N/A |
| 2307 | Fluid Mechanics | 15,014 | 15,470 | 15,540 | Continuing | N/A |
| 2308 | Energy Conversion | 11,905 | 9,426 | 9,963 | Continuing | N/A |
| 2309 | Terrestrial Sciences | 2,086 | 1,821 | 1,765 | Continuing | N/A |
| 2310 | Atmospheric Sciences | 12,311 | 10,628 | 10,507 | Continuing | N/A |
| 2311 | Astronomy & Astrophysics | 8,024 | 6,839 | 6,952 | Continuing | N/A |
| 2312 | Biological & Medical Sciences | 9,781 | 9,611 | 10,674 | Continuing | N/A |
| 2313 | Human Resources | 8,364 | 8,669 | 9,085 | Continuing | N/A |
| 2917 | University Research Instrumentation | 10,000 | 0 | 0 | 0 | 50,568 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology Base program element exclusively supports Air Force research efforts, comprised of in-house investigations in Air Force Laboratories and extramural activities in academia and industry. The program element funds broad-based scientific and engineering basic research dedicated to stimulating new ideas in areas pertinent to the Air Force mission: aerospace structures and aerodynamics, materials, propulsion and power, electronics, computer science, directed energy and conventional weapons, life sciences, and terrestrial, atmospheric, and space sciences. The efforts contained in this program do not duplicate tasks conducted under the Strategic Defense Initiative, or under the University Research Initiative. Special areas of interest in FY 1988 include: neural net computer architectures and processing; nonlinear optics; hypersonic flight; high energy density propellants; biotechnology for advanced aerospace materials and cognitive aspects of human performance. Major new initiatives in FY 1989 include: multifunctional wafer level union; nonlinear interactive flow control and flight mechanics; neurophysiology of sensory information processing and constituent mechanics of inhomogeneous materials. The effort also enhances the Air Force research capability by improving the

technological base in those areas crucial to the Air Force. Examples are support of a summer faculty and graduate student program wherein university researchers spend ten weeks during the summer working at an Air Force laboratory, a resident research associateship and university resident research program wherein researchers can spend up to a year at an Air Force laboratory; and several graduate assistantships and laboratory graduate fellowship programs in technology areas of critical interest to the Air Force.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 199,626 | 191,762 | 204,196 | Continuing | N/A |

EXPLANATION: (U) FY 1988 difference due to Congressional reduction. FY 1989 difference due to overall Air Force RDT&E budget reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Program coordination among government agencies is achieved through annual interagency meetings and data exchange with the Army, Navy, National Science Foundation, Department of Energy, National Aeronautics and Space Administration (NASA), Federal Aviation Administration, Defense Advanced Research Projects Agency, Defense Nuclear Agency, and other Federal research activities. Other means of coordination include annual briefings to the Under Secretary of Defense for Research and Engineering, attendance at technical symposia and topical reviews covering research areas of common interest. Examples of coordinating and joint activities are: a joint program in hypersonic aerodynamics is conducted in conjunction with the Navy and NASA; cloud physics is being jointly funded with the Navy and the Army using a jointly funded facility; a Joint Services Electronics Program supports relevant research at Universities to solve military electronics problems; an Interagency Working Group on Neuroscience coordinates efforts among federal agencies; mathematical sciences are coordinated through the Interagency Committee for Extramural Mathematics Programs. In addition, particularly effective coordination is accomplished on an informal basis among individual Air Force program managers and their counterparts in other agencies.

6. (U) WORK PERFORMED BY: The Air Force basic research program is conducted in Air Force laboratories and under extramural grants and contracts with academic institutions and industry. The entire program is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research now underway includes in-house efforts at the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH; Air Force Armament Laboratory, Eglin AFB, FL; Air Force Weapons Laboratory, Kirtland AFB, NM; Air Force Astronautics Laboratory, Edwards AFB, CA; Air Force Geophysics Laboratory, Hanscom AFB, MA; Air Force Human Resources Laboratory, Brooks AFB, TX; USAF School of Aerospace Medicine, Brooks AFB, TX; Air Force Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; Frank J. Seiler

Research Laboratory, USAF Academy, CO; Air Force Engineering Services Center, Tyndall Air Force Base, FL; and the Rome Air Development Center, Griffiss AFB, NY. The five major contractors for FY 1987 were: Mississippi State University, Mississippi State, MS; Stanford University, Stanford, CA; University of Southern California, Los Angeles, CA; Massachusetts Institute of Technology, Cambridge, MA; and Princeton University, Princeton, NJ. In FY 1987 contracts or grants were issued to 341 contractors in the amount of $158 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: This program element has thirteen projects in FY 1989. For FY 1989 several projects have been funded for less than $10 million. These projects are included below to provide the full scope of the Air Force Defense Research Sciences Program.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989:

(U) Project: 2301, Physics

A. (U) Project Description: This project provides scientific information to the technology base to help solve Air Force problems in new weapon systems development, electromagnetic countermeasures, nuclear weapons effects, communications, nondestructive and nonintrusive testing and analysis, and new materials development. To provide the necessary scientific knowledge, work is supported in optical physics, plasma physics, atomic and molecular physics, particle beam physics and pulsed prime power generation.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) A new laser concept was demonstrated at the very short wavelength of 106 nanometers. This was the first laser at such short wavelengths ever to efficiently extract energy from the laser material. The new laser concept promises to lead to the development of small scale, inexpensive x-ray lasers. (2) Laser photochemical techniques were devised for depositing metallic tungsten lines with micron scale resolution, on a substrate. This tungsten deposition is of major importance as a practical means of interconnecting microelectronic circuits. The use of these techniques to tune microwave integrated circuits, and also to connect circuits on chip carriers, has been demonstrated. (3) A vacuum-ultraviolet intensity-calibration standard light source has been developed that can be taken to the launch pad and used to calibrate satellite sensors immediately prior to launch. (4) Study of compact volume ion sources has led to an order of magnitude increase in current densities. This new generation source offers reliable and stable operation for proposed space based neutral particle beam systems.

(2) (U) FY 1988 Program: Research will continue to be concentrated in the following physics specialities: Optical Physics (nonlinear optics, short wavelength lasers, integrated optical/electronic devices, laser chemical physics, x-ray optics); Plasma Physics (e-beam millimeter-wave sources, charged particle accelerators, and artificial atmospheric plasmas); Atomic and Molecular Physics (atomic excitation and quenching processes, structure and dynamics of excited atoms, laser-matter interactions); Particle Beam Technology (ion sources, neutralizers, and beam propagation ); and Multimegawatt Space Prime Power Generation (power conditioning, storage, conversion of thermal

energy to electricity, thermal management of waste heat, new electric power concepts for space). In the field of plasma physics fundamental studies will be continued for plasma turbulence which blocks effective use of plasmas as reliable sources of coherent millimeter-wave radiation. Work will continue on a plasma physics computer simulation "user facility" which will employ a user-friendly, microcomputer-based, graphical, interactive, front-end so plasma physicists can efficiently control the sophisticated, multidimensional simulation codes run on the new classes of supercomputers. A new initiative will expand the range of studies of nonlinear optics. In particular, device applications of nonlinear optics will receive much greater emphasis. Studies of the properties of single atoms using laser cooling and particle trapping techniques will be continued. The use of these tools will provide more precise knowledge about the atom. Their use may reveal new properties of matter and may lead to advanced frequency and time standards. Semiconductor switching studies will receive increasing emphasis.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The advanced research efforts of the previous year are to be continued. Neutral and charged plasmas will be studied as potential sources for the efficient generation of millimeter- and submillimeter-wave radiation. Novel concepts will be studied for reducing the size and increasing the efficiency of high energy charged particle accelerators. Such devices could eventually be employed in directed energy weapons systems and in sources of tunable electromagnetic radiation. Methods will be sought for efficiently maintaining plasmas in the atmosphere. Innovative computer simulation techniques will be used as research tools to investigate and predict plasma behaviour for weapons applications. Under Atomic and Molecular Physics, a new program will be initiated in half-collisions, the use of laser light to break apart molecules and to study the dynamics and states of the resulting fragments. A new initiative will start in wafer scale union research. This initiative will study concepts related to the combining of sensors, electronic and optical circuits, and mechanical devices on single wafers. Previous research in processing, optical interconnection and control of electronic devices, and photochemical processing techniques will work together within this initiative. Studies related to soft x-ray laser generation, x-ray optics, and scientific applications of these wavelengths will be continued. Studies of novel laser based techniques for materials and device processing, and testing of microelectronic circuits will continue with emphasis on the application of these techniques to millimeter wave integrated circuits.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2302, Structures

A. (U) Project Description: This project pursues research directions supporting generic aerospace structure technologies, including structural dynamic-control interactions, nonlinear modeling and analysis, constitutive modeling and fatigue, and fracture prediction of metals, composites, and geotechnical materials. This research will generate new concepts to advance the generic technologies required for durable, superior high-performance weapon systems and installations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) A new design procedure has been developed which will facilitate the use of lighter weight, higher strength, higher temperature non-metallic structural materials. The design procedure will also permit more accurate predictions of a structure's anticipated life cycle. The new procedure is a modification of existing Linear Elastic Fracture Mechanics to account for a microstructural damage mechanism. Several major aerospace companies are using the procedure. (2) New experimental evidence indicates that saturated porous rock can liquefy under blast loading. This can substantially change the vulnerability of strategic protective structures. An analytical model has been developed which can predict when this behavior will occur.

(2) (U) FY 1988 Program: An initiative in Hypersonic Flight will address the requirements for very high temperature structures for applications such as the Aerospaceplane. Both cooled nonmetallic and metallic structures will be studied and the effects of coupled thermal and applied structural loads will be addressed. A new pavement technology study will be initiated to address the Air Force's needs for improved runway performance. The effort will be strongly coupled to the Department of Transportation's Strategic Highway Research Program. Emphasis will be on structural behavior and failure mechanisms of multi-layer systems, and cement and asphalt chemistry, failure mechanisms, and structure-property relationships. Work on the FY 1987 initiative in nonmetallic materials will continue to address constitutive properties, micromechanical deformation, damage response mechanisms in ceramic, carbon-carbon, and cementitious composite materials, and modeling and prediction of toughening mechanisms in multi-phase materials. Structure-controls interaction studies will continue for large space structures. Structure-fluids-controls interaction research will continue emphasizing supermaneuverability and the harnessing of unsteady flow and structural deformation coupling in flight structures. The influences of the physical properties and the microstructure of geotechnical materials upon their response to operational loadings will be studied to improve durability and damage tolerance. The influence of soil characteristics on blast-induced liquefaction and on load carrying capacity will be investigated to improve the performance of soil subjected to nuclear and conventional weapons.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: New thrusts include inhomogeneous constituent material mechanics, deformation of granular materials, and heuristic (learned) structural analysis/synthesis. Efforts in hot structures, metallic materials, and nonmetallic materials research will be continued. Active and passive cooling of hot structures will be investigated using both simulations and coupled mechanical-thermodynamic models. Characterization of constitutive behavior and damage mechanisms in ceramic, carbon-carbon, and cementitious composite materials will be pursued. A new thrust in computational thermo-inelasticity will seek to integrate newly developed capabilities in microstructural constitutive models, macrostructural thermoviscoplastic models, nonlinear field equations of state, and parallel numerical algorithms to provide numerical simulations of high velocity flight and other high temperature structural applications. Structure-fluid-controls interaction research will continue to address stability issues in supermaneuverable flight and nonlinear dynamics and control of large space structures, particularly under deployment and slew maneuvers. Efforts under the FY 1988 Initiative in Pavement Technology will continue to address improved runway performance requirements. Dynamic response of protective structures subjected to impulsive loading will be further investigated.

Efforts will also be continued to develop fabric-deformation relations of soils and other geotechnical materials to establish more rational constitutive laws.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2303, Chemistry

A. (U) Project Description: Advances are sought in Air Force technological capabilities in structural and electronic materials, geo-environmental characterization, electromagnetic and conventional weaponry, electrochemical power systems, and rocket propellant ingredients. Specific research emphasizes synthesis and characterization of higher performance, lower cost nonmetallic materials for application as structural composites, lubricants and sealants. A detailed description is sought of atomic level interfacial contamination responsible for limitations in performance of electronic devices. Also under investigation is the reaction chemistry of the upper atmosphere that controls the density of the ionosphere as well as the intensity and spectral distribution of infrared background radiation. These factors limit the availability of radio communications and sensitivity of satellite surveillance systems. Separate but similar investigations of molecular energy release mechanisms foster advances in laser weapon development.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The ultrastructure processing approach was successfully applied to the fabrication of high temperature ceramic superconductors. Through the concept of microreactors, sol gel reactions are conducted in emulsion droplets to form narrow-sized distributions of the complex baria-yttria-copper-oxygen particles. Patterned superconductors for microwave applications have been sintered on ceramic substrates with excellent stability, structure uniformity and critical temperatures in the vicinity of 90 degrees kelvin. Nonlinear optical polymers have been developed with second harmonic generation coefficients which are ten times higher than the inorganic crystals such as lithium niobate. Since these polymers also have higher electrooptic coefficients, several designs of electrooptic modulators have been constructed which demonstrate operation in the Gigahertz radio frequency region. This accomplishment transitioned to a development program to construct electrooptic Bragg Cells for high speed radar signal processing. Recent announcement was made of the commercialization of these polymers and devices. Observed for the first time was a chemical reaction on a time scale that allowed a detailed study of the reaction as it was actually proceeding. Light emission from the molecule varied on a femtosecond time scale (the amount of time it takes for one vibration) as the molecule was actually dissociating. The payoff of this technique is detailed understanding that will allow design of efficient chemical lasers with much more confidence.

(2) (U) FY 1988 Program: Research on ultrastructure materials will be strongly emphasized with the three following major research efforts being strengthened: (1) New structural polymers will be synthesized and the relationships of molecular structure to end use properties determined. (2) Advanced liquid crystalline polymers for application as ultrafast response nonlinear optical (signal processing) materials will be evaluated. (3) New classes of tough ceramic/ceramic composites will be produced by sol/gel processing for advanced high performance turbine engine component applications. New high energy content, long storage life propellant binders will be synthesized. Research on the kinetic mechanisms of thermal decomposition of explosives will result in improved insensitive high explosives. Research on the molecular level oxidation kinetics of fuels will pinpoint the details of energy release and assist design of advanced ramjet engines with higher operating performance. Erosive and luminescent surface reactions encountered in space by satellites will be investigated using laboratory simulations. New research initiatives are planned in high priority areas: metastable molecular energy storage (as a basis for advanced high energy density rocket propellants), low cost synthesis of high performance polymers by application of biotechnology and molecular mechanisms of solid lubrication.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Ultrastructure materials approaches will be applied to new classes of nonlinear optical materials--inorganic compounds and nanometer composite structures containing both organic and inorganic phases. The basis for higher energy density, longer lifecycle space power systems will be sought with expanded research in electrochemistry. Because of the importance of solid lubrication in future high performance turbine engines the research effort on tribology will be expanded. Research on processing ceramics from organometallic precursors by pyrolysis will shift its emphasis to include sources for high temperature materials containing zirconium, hafnium, titanium, and tantalum. Research in spectroscopy and chemical kinetics will seek to support future space-based surveillance systems by characterizing ultraviolet sources in exhaust signatures as well as atmospheric backgrounds.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

11. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2304, Mathematics

A. (U) Project Description: The research in the mathematical and computer sciences seeks discoveries to provide understanding and to solve problems of critical importance to the Air Force. The topics include control of aerospace systems; models for the design of aircraft, missiles, or other weapons; efficient production of large-scale, well-documented computer programs and software; communication and information theory; artificial intelligence in surveillance systems or independent weapons; reliability, availability, and maintainability; and the allocation of resources in logistics or operational activities using optimization theory.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) Clear and effective radio communications can be achieved only if the assignment of radio frequencies is done so that interference is avoided. New mathematics have been developed using graph theoretic techniques which are useful in evaluating current frequency assignment methods and in devising more efficient computer assisted methods of assignment. (2) New and more efficient computer algorithms have been developed for solving linear programming problems. These problems are used to model a wide variety of problems in such areas as optimal scheduling and command and control. The new algorithms have several advantages over previously published algorithms, including speed and providing data on the sensitivity of the solution to the original data. (3) Modern flight systems depend very heavily on feedback control mechanisms. A theory for analyzing control laws has existed for a number of years, but the computational burden had prevented its application. Recent research has developed a way to derive the solution to the theoretical model, thus enabling control design and analysis to be accomplished so that system performance is maintained despite uncertainty in the operating conditions. (4) New advances in the analysis of fault-tolerant networks have been used in the design of a new type of computer chip. These new chips exhibit superior performance and fault-tolerance while being cheaper to produce than standard chips. (5) New mathematical analysis has led to an understanding of the occurence of multiple steady states in fluid flows. This is an extremely important research problem needed for several applications, including the design of high-performance aircraft.

(2) (U) FY 1988 Program: A major enhancement of the program in mathematics will emphasize research in nonlinear phenomena with particular emphasis on coherent nonlinear waves, nonlinear dynamics (chaos) and the attendant fractal descriptions. These three paradigms have emerged as the major breakthroughs in the effort to understand nonlinear continuum mechanics and electrodynamics. The bifurcation of coherent waves into temporal and/or spatial chaos provides a remarkable description of phenomena such as clear air turbulence and nonlinear bistable (laser driven) optical devices. This new effort will seek both analytical and numerical approaches to the questions posed by modern technology and encapsulated in the nonlinear partial differential equations written as models. A new initiative in the artificial intelligence program will emphasize research in neural architectures and processing. Artificial intelligence has had notable successes in producing systems that rival, or even exceed, human performance in specific, problem solving domains. However, the continued use of uniprocessor systems will present an insurmountable obstacle to future progress, particularly in the area of large knowledge-based systems, speech understanding, large and robust natural language processing systems and computer vision systems. The theoretical maximum performance of uniprocessor systems is several orders of magnitude below the performance levels required for desired systems. Furthermore, uniprocessor systems are not fault tolerant. A new computational paradigm is needed that is intrinsically parallel and fault tolerant. Highly connected, asynchronous, memory distributed architectures, suggested by neural systems, offer promising approaches for overcoming the limitations of uniprocessor systems. This initiative will support research on neural based architectures for artificial intelligence processing, which strongly underpins Air Force emphasis on knowledge based systems technology. Projects of interest range from those concerned with developing mathematical theories of how self-organization and learning proceeds in neural networks to simulations that provide a secure foundation for designing hardware implementations, to physical realization of architectures. Enhancements to ongoing high quality initiatives and core enhancements in computational mathematics, artificial intelligence, large scale optimization on computers, computer aided quality control, distributed parameter control and expert systems will continue to be emphasized. Supercomputer technology and availability will continue to have a

major impact on the investigators who are seeking solutions in computer architectures, large algorithms, expert systems and optimization theory.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new research initiative in parallel algorithms for large-scale optimization will be started. Emphasis will be on developing new optimization techniques for nonlinear optimization problems facing the Air Force. These problems are common to such disciplines as flight control, and structural and fluid dynamics. Methods for properly scaling the search domain and for handling the inequality constraints will be pursued. As a natural continuation of our emphasis on developing algorithms for the emerging, powerful multiprocessor computers, the optimization codes developed under this initiative will be targeted at such machines. A new research thrust in acoustic and radar scattering together with tomographic nondestructive evaluation will also be initiated this year. Recent conceptual breakthroughs in this field offer great potential benefits. Contributing to the knowledge-based systems technology, the work on expert systems will increase emphasis on handling application domains that have an inherent time-dependence such as is typical in real-time problems (system monitoring, target acquisition, pointing, and tracking, etc.). Complex Air Force applications include such parameter dependent problems as structural buckling, nonlinear optics, and the Navier-Stokes equations describing fluid flow. In addition to pursuing promising new approaches to obtaining qualitative results for such problems, emphasis will be placed on novel computational techniques that are effective in tracing out solution manifolds for these challenging applications. Continued emphasis will be placed on such fundamental, ongoing problems such as providing parallel programming environments in this new multiprocessor computer era, control of distributed parameter systems for problems modeled by partial differential equations, improved communications techniques over noisy and degraded channels, and statistical methods that allow for more realistic models of system reliability. A new effort in spatial statistics will be started. Emphasis will be on developing new statistical procedures to interpret and analyze large data sets in the multi-dimensional space-time domain. This emphasis will support many of the new technologies and systems which require real-time synthesis and analysis of data collected by multiple sources.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

12. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2305, Electronics

A. (U) Project Description: Electronics research provides fundamental knowledge required to advance Air Force capabilities in surveillance, guidance and control, information and signal processing, electronic warfare, and communications, command, and control. Research topics include optical signal processing for target recognition and terminal guidance, semiconductor devices for high speed digital and analog signal processing, and microwave and millimeter wave signal and power generation, electromagnetic propagation, antennas, target signatures, microwave tube science, superconducting analog signal processing, robust communications techniques for command and control, and nuclear radiation hardening of electronic circuits and devices.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) Standard silicon integrated circuit processing has been used to fabricate an infrared array composed of platinum silicide photo-electrodes. Infrared images are sensed by a process called internal photoemission giving an electrical current proportional to the image intensity. This results in a simplification of the detection process in a fashion similar to visible sensors. Both signal sensing and accumulation take place in the silicide. This eliminates most of the factors which cause detector array non-uniformities. The infrared internal emission was found to be even more uniform than the intrinsic visible response of the same array. The initial research program has been highly successful. Based on careful modeling and simulation, very large, uniform arrays, with as many as 100,000 detectors have been fabricated. Both laboratory and field tests were conducted at Air Force Wright Aeronautical Laboratory. Smoke and fog penetration tests were conducted at Eglin Air Force Base. These tests compared silicide cameras to conventional long wavelength infrared scanning systems. There were no significant differences between the systems in smoke. In warm fog the silicide sensor had a range advantage while, in heavy cold fog the scanning system had the advantage. A very important result of these tests was the demonstration that state-of-the-art thermal imaging is possible in the medium wavelength infrared band. (2) The physical processes controlling current flow in high power switches has been studied and modeled and an optimum geometry for a compact, high power switch has been found. In a special hollow electrode configuration, switching can be triggered by a laser pulse or even a flash bulb. The light pulse causes a weak current to flow at one electrode of the tube which is pulled by the applied field toward the other electrode, thereby closing the high power current path. Although the dimensions of the tube amount only to a few inches in diameter and length, the tube can withstand voltages of greater than 35 thousand volts and switched peak currents of greater than 15 thousand amperes have been observed. By comparison, a household switch turning on an electric light bulb has to control only 110 volts and one ampere. Equally impressive is the fast response of the switch. The switch can turn on three thousand amperes in less than ten billionths of a second. These characteristics are uniquely suitable for switching power to operate large, powerful laser and radar systems. The size and predicted reliability of the new tube will substantially improve space-based systems. (3) A new standard of performance for a class of semiconductor electronic devices known as the Double Barrier Quantum Well Structure (DBQW) has been established. This structure promises greatly improved capabilities for both digital (higher processing speed) and analog (higher operating frequency) circuits. The record performance is due to superior material quality and an advanced design. The growth technique employed to meet the stringent material requirements is known as molecular beam epitaxy (MBE). The term quantum well refers to the quantum mechanical nature of the electronic energy states when charge carriers are confined to very small regions. In this case, the confinement is due to the aluminum gallium arsenide layers. The electronic states are formed in the undoped gallium arsenide region between the barriers. A figure of merit for negative resistance devices is the ratio of the peak current to the minimum (or valley) current in the region of the current dip. The state-of-the-art for peak-to-valley current ratio was improved by seventeen percent. The improvement at low temperatures (77 degrees kelvin) is even more impressive - over 200 percent. (4) In recent years our knowledge of complex electronic speech processing has increased dramatically. New work has extended these achievements making even more Air Force applications possible. Instead, of mapping or translating text to speech, a neural network model has been used to translate images of the speaker's face into spoken speech. The network is taught to read the lips of the speaker and translate the "seen" speech into "spoken" speech. Results indicate that a rather small neural network (less than 400

neurons) has learned to recognize a limited number of mouth primitives (called visemes) such as vowels and diphthongs and has demonstrated superior performance over previous neural network speech interpretation schemes. Such nets will be useful in hostile environments where the sound level is so loud that the spoken word could not be heard or recognized. Such environs range from the automated manufacturing floor to the pilot's cockpit where electronic means are already being used to enhance the audio-signal in communication.

(2) (U) FY 1988 Program: The program will be increasingly directed toward the Air Force needs in adaptive signal recognition and processing. Consequently, research will be supported on materials and devices which will improve photonic and electronic signal and data processing functions, on transmission of data and on signal processing sciences which emphasize the programmability and massive parallelism needed to support the development of knowledge based systems technology. Research to be pursued will impact on future technologies to provide for "intelligent" weapons targeting and guidance systems, fault tolerant systems and support missions requiring artificial intelligence electronic materials and device research will emphasize structural dimensions between one-tenth of a micron and a few angstroms. This quantum size domain requires ultimate control of structural quality such as defects, dislocations and abruptness of features. Novel devices, particularly for millimeter wave applications in support of Wafer Level Union, will be pursued making use of new carrier transport phenomena expected to be observed in those quantum structures. Also new approaches to integrated circuits based on quantum tunneling and hot electron effects will be supported. Tailoring materials properties for new optical, electronic and magnetic devices will be accomplished. The reliability and radiation hardness of these new devices will be carefully analyzed. In addition to maintaining the present overall program emphasis, a new initiative is planned in neural architectures and signal processing. This effort aims at approaches which are adaptive, self-learning and massively parallel and thus supports the urgent need for novel ideas in artificial intelligence and integrated photonic systems.

(3) (U) FY 1989 Planned Program and Basis For FY 1989 RDT&E Request: Fundamental research in electronics will be focused predominantly on optical and millimeter wave implementations of highly efficient novel architectures. Device physics and problems arising from fabrication of ultra-small devices will be studied and applied to the spectral windows of interest. Superconductive electronics will be investigated and compared with existing standard electronics. Strong emphasis will be on matching signal processing algorithms to the chosen hardware implementation for overall systems performance. Propagation issues will be analyzed that impact radar scattering or adaptable radiation pattern control in adverse environments. This program is well coordinated within the AF laboratories.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

13. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2306, Materials

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A. (U) Project Description: The materials research program provides the knowledge required for improving the performance, cost, and reliability of structural and electronic materials. The structural materials research program studies a broad range of material properties, such as strength, fatigue resistance, and corrosion resistance of airframe, turbine engine, and spacecraft materials. Emphasis is on titanium, aluminum, and nickel-based alloys, advanced composites and ceramics. Research in new production methods and nondestructive evaluation of these materials complements research on materials properties. The electronic materials research program is concerned with semiconductor, optical, and magnetic materials used in avionics, surveillance, communications, guidance, and electronic warfare. Emphasis is on compound semiconductors, superconductors, materials for infrared fiber optic systems and nonlinear optical materials for signal processors.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) The high temperature oxidation resistance of niobium-based alloys for gas-turbine engine applications has been improved. The requirements for alloying are driven by the need to limit any oxidation to the surface of the material and to prevent oxygen from diffusing into the material. Extensive thermodynamic, kinetic and chemical modeling has shown that three key fundamental factors may be controlled to help achieve this goal. The first is a reduction of solid solubility of oxygen in niobium by alloying it with high electron-to-atom ratio elements such as hafnium or zirconium. The second approach is to reduce the diffusion coefficient of oxygen in the niobium lattice. Finally, increasing the diffusion coefficient of aluminum in the niobium lattice by co-alloying with chromium or vanadium would ensure the surface layer is always aluminum oxide-rich. These three requirements were found to control the development of high performance niobium alloys with ability to form protective aluminum oxide scales up to 1600 degrees centigrade. This approach to the design of oxidation resistant niobium alloys has shown considerable merit. Currently, exploratory development programs are being considered to develop rapidly solidified niobium alloys with fine microstructures necessary to preserve the conditions predicted by the model. (2) Superconducting films have been produced with the highest current carrying capacity yet reported for operation at liquid nitrogen temperature (-196 degrees centigrade). This breakthrough is the first indication that the newly discovered class of ceramic oxide superconductors can be fabricated in a useable form for application to high frequency sensing and high speed signal processing devices at easily achievable temperatures. Effective passive thermal shielding in space vehicles can yield an ambient temperature of -193 degrees centigrade, and thus active refrigeration may not be required for these new "high temperature" superconductors. A world record critical current density for yttrium barium copper oxide films was achieved by using a three-gun electron beam evaporator to produce epitaxial growth on a strontium titanate substrate. Other high quality films have been formed using sputtering and molecular beam epitaxial growth methods. A new structural phase of this material has also been uncovered which is superconducting in the range of -183 degrees centigrade and which features distributed oxygen vacancies. This discovery may be quite useful in helping to understand the underlying structural features which give rise to superconductivity in ceramic oxides. (3) The physics, chemistry, and materials issues relevant to vacuum tube amplifiers were investigated to establish a relationship between device preparation and performance. First, the electronic bonding and geometric nature of the barium monolayer was studied to find conditions that would prevent evaporation, and second, a reproducible impregnation procedure that would result in complete chemical reactions. Studies revealed a specific molecular bonding orientation that would not evaporate from the cathode surface and was

optimal for thermionic emission. By monitoring the solid state chemistry of formation during the impregnation, three prototype cathodes possessing the desired molecular configuration were fabricated. If one accepts the rule-of-thumb that a 50 degrees centigrade decrease in operating temperature corresponds to a doubling of expected lifetime, then these new thermionic emitters are expected to show an astounding 64-fold increase in life expectancy. Benefits from the development and use of this new thermionic cathode will result in reproducible and predictable cathodes which are key to the operation of vacuum tube amplifiers for future Air Force radar and satellite communication systems. In addition, these new cathodes can be operated at higher temperatures, producing the enormous current densities necessary for a new generation of ultra-high power devices.

(2) (U) FY 1988 Program: In addition to continuing the successful investigations, new thrusts are planned to develop understanding of the effects of microstructure on macroscopic behavior of structural materials, particularly as related to hybrid materials composed of heterogeneous and multiphase microstructures. Attempts will be made to fundamentally model as well as quantum mechanically formulate and understand surfaces and interfaces in materials. In-depth understanding of microstructural behavior will enable the structural designer to select the best, most reliable materials required to meet specific Air Force missions, especially in the important areas of engines and structures for hypersonic flight. The overall program continues to emphasize evolutionary improvements in existing materials while searching for revolutionary new classes of materials. In the area of electromagnetic materials, emphasis continues on those materials issues that influence device behavior. In particular, research leading to an understanding of thin films and artificially structured materials and the role of processing on device parameters will be strengthened. Research will continue on high temperature structural materials and electromagnetic materials.

(3) (U) FY 1989 Planned Program and Basis For FY 1989 RDT&E Request: Research on very high temperature structural materials for skins of high Mach number aircraft and for advanced propulsion systems, and on material issues that impact on electromagnetic device behavior will be emphasized. Metal, ceramic, carbon-carbon, cement and hybrid material issues will be pursued, as well as processing science on structural and electromagnetic materials. Continuing emphasis will be maintained on high temperature structural materials and electromagnetic materials. Experimental research activities will be initiated to confirm successful output of first-principles computations of physical and mechanical properties of materials.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

14. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2307, Fluid Mechanics

A. (U) Project Description: Fluid mechanics research provides knowledge essential for improving the efficiency and effectiveness of Air Force flight vehicles. The research seeks to provide physical understanding of key flow phenomena, to devise improved theoretical models based on that understanding, and to originate concepts which will

expand current aerodynamic performance boundaries. Future directions in aircraft performance requirements will include better range and fuel efficiency, capability to operate from shortened or damaged runways, capability to maneuver in the post-stall flight regime and capability to fly at sustained hypersonic speeds. These technology needs motivate research directions to better understand aerodynamic drag generation in turbulent flows, the characteristics of jet-interacting flow fields, convective heat transfer in gas flow, the characteristics of time dependent, three-dimensional separated flow and the computation of flows with nonequilibrium chemistry. The results of fluid dynamics research will provide the background necessary to assure the design and production of superior flight vehicle weapons systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) A new shock-free swept blade design has resulted in an increase in gas turbine compressor efficiency of 5 percent. (2) A new grid generation technique allows computation of aerodynamic flow around complex shapes (e.g. wing with stores) which could not previously be accurately modelled. (3) A new flow visualization technique has been developed which can provide three-dimensional flow data in supersonic flows. The procedure consists of exciting oxygen molecules using two laser beams then, further downstream, using a third laser beam to stimulate the excited molecules to fluoresce.

(2) (U) FY 1988 Program: An initiative in Hypersonic Flight will emphasize the real gas effects in hypersonic aerodynamics and the complex airframe propulsion system integration, especially with respect to shock interactions. Emphasis will continue on investigations of unusual flow separation phenomena responsible for extremely high lift levels for wings undergoing rapid, large amplitude motions. Research will focus on dynamic stall of three-dimensional lifting surfaces and generic characteristics of driven unsteady separated flows. The capability for real-time active control of isolated separation vortices will be sought. Better understanding of the structural features of turbulent shear layers has potential technological impact in such areas as skin friction drag reduction and control of turbulent mixing. Algorithm development for faster computing speeds will continue in an effort to exploit new supercomputer architectures. Faster and more accurate Computational Fluid Dynamics methods will allow development of new flight vehicles. In internal fluid dynamics research, experimental and computational approaches will be pursued to identify the loss mechanisms that are driven by blade motion.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new thrust in interactive flow control will provide the basis for control of aerodynamic flows, mixing, and combustion. Research in nonlinear flight mechanics will provide the basis for future high maneuverability vehicles. Research will continue in hypersonic aerothermodynamics with emphasis on real gas effects, strong viscous interactions and transition to turbulence in high speed boundary layers. Research on unsteady separated flows will continue to explore the generic characteristics of driven separation in three dimensions, with increasing emphasis on real-time active control of separation vortices. This research along with studies of control of turbulent mixing of shear layers and improved heat transfer prediction in turbine blade rows will support higher performance propulsion systems. Major emphasis on improved understanding of the structural features of turbulent shear layers will continue due to the potential technological impact on the performance of most fluid mechanic devices of interest to the Air Force.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

15. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2308, Energy Conversion

A. (U) Project Description: This project is concerned with reacting flows, combustion, and energy conversion in propulsion, weapon and power systems. It includes both airbreathing combustion and non-airbreathing chemical rockets, as well as propulsion systems using electrical, nuclear, laser, or solar energy sources. New knowledge is sought for the use of advanced liquid, slurry, and solid chemical propellants for improved performance and safety. Technology needs include reduced exhaust signature, control of combustion instabilities, reductions in maintenance costs, and improved performance and durability. New diagnostic measurement capability is needed for both laboratory research and on-board control. The goal is to reduce the cost and to increase the flexibility, durability, and performance of future Air Force systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: A new rocket exhaust plume prediction model has been utilized to reduce contaminating back flow. The new Direct Simulation Monte Carlo technique more accurately predicts molecular movement than the classical equilibrium gas dynamic model, and can account for non-equilibrium effects. It was utilized to redesign the tip of a Mach 7 conical model, resulting in a predicted 30 percent reduction in contaminating back flow.

(2) (U) FY 1988 Program: An initiative in hypersonic flight will emphasize photochemical means for ignition and flameholding in supersonic combustion devices while simultaneously reducing thermodynamic efficiency losses associated with these processes. Multidimensional modeling of plasma propulsion physics also will receive priority attention. Work in Gas Turbine Hot Section research will continue with emphasis on simulating turbulent reacting flows, inhibiting soot formation and producing durable nonmetallic materials. Research in space propulsion will include thermal management, plasma stabilization and thermionic energy conversion. This research will provide the necessary knowledge to obtain the fourfold increases in orbit-raising propulsion efficiency needed for the large communications and surveillance satellites. Attention will be given to advanced diagnostics for performing research on energetic materials, particularly rapid condensed phase processes. Research will continue on new techniques which are essential in understanding combustion systems, air breathing and rocket engines, and effective fuel use. Continuing research will be directed at the dynamics of high-speed turbulent steady-state flows and transient chemically reacting flows with emphasis placed on realistic modeling and characterization of the flow field, processes, and phenomena occurring in dump-type ramjet, gas turbine, and ducted rocket combustors. Efforts relating to rocket combustion dynamics will continue to be emphasized with the goal of improved performance. These studies will lead to higher performance, more reliable, less detectable rocket motors.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new thrust in interactive flow control will provide the basis for more effective combustion control. The findings of FY 1987 research on the limitations of mixing and combustion under supersonic flow conditions will be coupled with advances in mathematical chaos and control theory to enhance the rate of energy release for scramjet propulsion systems. Growth will continue according to the FY 1987 initiatives in combustion enhancement and plasma-based propulsion, the FY 1988 initiative in hypersonic flight and the other priorities established in FY 1988.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

16. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2309, Terrestrial Sciences

A. (U) Project Description: This project provides basic research in geodesy, gravity, and seismology to understand the problems associated with increasing missile accuracy and test ban treaty verification. Research in geodesy is required to determine the exact position of targets with respect to missile launch sites. Research in gravity is required to determine its effect on missile guidance systems along flight paths. Research in seismology is required to determine the effects of earthquakes, nuclear explosions, and other natural or system-generated noise on the degradation of missile guidance systems before launch as well as on other Air Force systems and facilities. Research in seismology is also required for detection, discrimination and yield determination of nuclear test explosions.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) Air Force Geophysics Laboratory scientists have carefully measured gravity along a 2000 foot high television tower. The initial results indicate the presence of a non-Newtonian component in the gravitational constant. These results are consistent with and complementary to results obtained by other researchers in mine experiments. A more complete knowledge of gravity improves our ability to model the Earth's gravitational field. (2) A compact, superconducting, six-axis accelerometer has entered testing. This accelerometer exhibits low noise, is highly sensitive and has a large dynamic range. This device will eventually be part of a space-borne gravity measurement system. (3) The near and far-field ground motions have been measured for quarry blasts in New England. From these measurements, scientists are able to determine quarry blast signatures as well as the transmission properties for this stable continental crust. Studies of quarry blast signatures are important for discrimination of possible clandestine nuclear weapons tests.

(2) (U) FY 1988 Program: The nature of the seismic coupling between the ground and surface and air explosions will be studied using Air Force Geophysics Laboratory (AFGL) observations of several Defense Nuclear Agency nuclear simulation tests. Results of AFGL seismic experiments in Maine, New Mexico, and Nevada will be used to infer properties of the crust in these areas. Maine is a geologic analogue of the Soviet Union, while Nevada and New Mexico

are potential small missile basing sites. Portable Global Positioning System (GPS) receivers will be used to measure the earth's viscoelastic rebound following the 1959 Hebgen Lake, Montana earthquake. Testing of the six-axis cryogenic accelerometer will begin. This instrument will be a major component of a space-borne gravity gradiometer (jointly developed with National Aeronautics and Space Administration) to be mounted in the space shuttle for global measurements of the earth's gravity field. Such data permits improvement in ballistic missile accuracy. Final assembly will begin on an automated astronomic azimuth/latitude device using a laser gyro as the sensor. This instrument will have potential application for Defense Mapping Agency field use in weapons siting. Several experiments will be completed to confirm or deny the gravitational "fifth" force. The existence of such a force carries profound implications for all of classical physics as well as for current theories of the earth's gravity field. Testing of a new design gravity gradiometer will be completed with NASA's assistance at the Marshall Space Flight Center. This instrument will have potential as an air- or space-borne instrument. GPS radio receivers will be located at a European Astronomic Observatory increasing our GPS coverage for refining satellite orbits. Orbital position accuracies in the order of one part in $10^8$ are envisioned. GPS orbital data will be supplied to the GPS program office at Space Division.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Research in Terrestrial sciences will be concentrated in geodesy, gravity and seismic motion. Geodetic sciences research will be aimed at improved position location for regions where GPS receivers cannot be placed. GPS location techniques will also be used to further study stresses and earth motion in tectonically active regions. The AFGL will investigate accurate GPS positioning and location determination for arrays of small satellites. The study of gravity will concentrate on the region of the atmosphere between high altitude (approximately 100,000 feet) and the surface of the earth. This effort will more precisely define the actual gravity vector in magnitude and direction above the surface of the earth. Seismic studies will address source mechanisms and source seismic signatures. AFGL will continue to study the earth's crust in New England as well as study crustal motion associated with Defense Nuclear Agency nuclear simulation tests.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

17. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2310, Atmospheric Sciences

A. (U) Project Description: Research in the atmospheric sciences includes the physics, dynamics, and chemistry of processes which determine the structure and variability of the earth's atmosphere. Atmospheric properties such as wind, density, clouds and precipitation, ionization, and optical and infrared transmissivity and emissivity all affect the performance of Air Force systems. A major effort is devoted to the development and use of new measurement techniques and the development of models for predicting weather and other atmospheric conditions. Emphasis is placed on understanding atmospheric effects on optical and infrared weapons systems and on understanding the dynamics and structure of the ionosphere which affect communications and surveillance systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: A new rapid model for weather forecasts can successfully predict localized severe storms. The method requires minutes on a microcomputer. It is ideal for on the spot battlefield local forecasts. The approach can take the global scale forecast provided by the Air Force Global Weather Central and nest within it a small, state-size grid containing local details of terrain such as river valleys and mountain ranges. These details profoundly effect the localized severity of rain storms and flooding. The method is now under evaluation by the Air Weather Service (AWS) as an important component in a program of distributed weather prediction. A different sort of forecasting is required for the constantly changing polar ionosphere which determines the effectiveness of ground to satellite communications and over the horizon radar surveillance. A big step forward in realistic forecasting is due to observation of previously unknown phenomena. Observed were giant (500 mile diameter) patches of electrons racing across the polar cap (from the sunlit side) at velocities up to 7,000 miles per hour. This effect, which impacts the structure of the ionosphere all the way to the Equator, is incorporated into a new semi-empirical, low latitude model (SLIM). It requires two minutes of computer time in comparison with up to two hours required by earlier less accurate models. SLIM is now being incorporated by HQ AWS into their routine global ionospheric forecasts. It will improve the regional detail of the ICED (ionospheric conductivity and electron density) model transitioned last year.

(2) (U) FY 1988 Program: Research will continue to emphasize mesoscale (battlefield scale) weather processes and ionospheric dynamics. Still more accurate analysis and forecasting of irregularities in the ionosphere will be sought. Global scale description of the time varying structure, composition, and dynamics of the ionosphere, but with special emphasis on the auroral region, will afford accurate prediction of the reliability of radio frequency communication. Understanding will be sought of the basic chemical and physical processes in the upper atmosphere responsible for optical, ultraviolet, and infrared (IR) background radiation in order to assist development of the most sensitive, reliable space-based and airborne multispectral surveillance systems. Special concern will be placed on the complex origins of oscillatory patterns in IR emission for active/passive broad spectrum signature control. Field observations will be combined with laboratory simulations and theory. Research in meteorology will continue to shift from global scale to mesoscale forecasting of increasing accuracy and longer lead time. Emphasis will continue on explicit incorporation of moisture in the model to afford accurate predictions of cloud formation and precipitation.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Research will continue to focus on efforts needed to provide the technical basis for environmental support to advanced technologies and future systems. Better analytic and predictive capabilities are needed in the upper stratosphere and the ionosphere to more accurately specify electron density profiles, especially when associated with geomagnetic storming which can adversely impact sophisticated communications systems, low orbiting spacecraft, and other systems sensitive to the effects of the near earth-space environment (e.g., advanced aerospace plane, pulsed and directed energy weapons, etc.). New breakthroughs are also needed in order to remotely sense atmospheric density and aerosols and specify them over any given point at any time along any path to provide necessary guidance for optimum utilization of state-of-the-art electro-optical and radar systems. Future battlefield weather support will require sub-mesoscale, asynoptic analysis and predictive capabilities to enable the field commander to use his forces and weaponry efficiently. New data assimilation,

modeling, and dissemination techniques are essential to support advances such as the super cockpit, brilliant guidance, and other knowledge based systems.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

18. (U) PROJECT LESS THAN $10 MILLION IN 1989:

(U) Project: 2311, Astronomy and Astrophysics

A. (U) Project Description: This project provides basic knowledge of the space environment for the design and calibration of advanced Air Force systems. It also supports the Air Weather Service by improving observing and forecasting techniques that support operational military systems. Space environmental conditions produced by radiation and charged atomic particles can endanger the mission and degrade the performance of military spacecraft, disrupt the detection and tracking of missiles and satellites, distort communications, and interfere with surveillance operations. Experimental and theoretical means are used to study methods to improve space surveillance systems and to study solar outbursts and their travel to the earth where they affect communications and satellite systems. Also being studied are the composition of the space environment in which Air Force systems operate, changes caused by natural and man-made disturbances, and the response of spacecraft systems and operations to the space environment.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The innovative joining of a number of new techniques has resulted in the first successful image reconstruction of solar features that are largely free of environment induced artifacts. The resulting high resolution solar images provide the capability for developing reliable solar activity forecasts for military operations in space. It was found that nearly simultaneous disturbances in the interplanetary medium observed by spacecraft on opposite sides of the sun did not result from a single widespread solar-flare-initiated interplanetary shock but instead could be attributed to at least two or more independent shocks, each limited in azimuthal extent. This result simplifies the forecasting of solar-flare initiated geomagnetic disturbances which are responsible for adverse effects on Air Force systems ranging from increased satellite drag to degraded high frequency communications. A unified model has been developed that explains both the geomagnetic substorm-related dynamics of auroral activity and the concurrent generation of magnetic pulsations. This model is a major improvement in understanding the physical processes involved in substorms which have a significant impact on Air Force surveillance and communication systems at high latitudes. A new form of electromagnetic radiation generated when the current carried by an electron beam emitted into a magnetized plasma exceeds a critical level was discovered and analyzed. The Air Force has an increasing interest in the use of modulated electron beams in space as virtual antennas for the emission of very low frequency and ultra-low frequency waves in space. Operations of ground-based instrumentation has resulted in the spectroscopy of several bright infrared stars with spatially resolved structure. The definition of

the spectral, spatial and temporal signatures of the infrared celestial background permits the Air Force to develop effective discrimination techniques for space-based surveillance systems.

(2) (U) FY 1988 Program: This research addresses some of the most important unsolved problems in solar-terrestrial science. The rapidly expanding role of space in Air Force and Department of Defense operations and missions require a significant advancement in understanding of the space environment, the development of a new generation of state-of-the-art sensors, significant expansion of the space parameter data base and new computer simulation capabilities. Research is carried out on the components of the system (sun, interplanetary medium, and magnetosphere) and on the connections between them. Research is carried out in space, in the laboratory, and through analytical, theoretical and computer codes. Active space experiments represent an important new approach to the study of the space environment. The inclusion of a task to gather and analyze infrared stellar and celestial background data and to improve ground-based instrumentation indicates the importance of stellar and celestial sources to the problem of infrared surveillance activities. Major activities include the development of instruments for solar activity measurements, satellite payload including solar magnetic fields and extreme ultraviolet measurements with a goal of developing precursors for major solar eruptions that degrade or destroy an Air Force satellite systems or which can produce false targets. Solar flare energy buildup and magnetic field gradients will be studied with the goal of generating new empirical flare forecasting codes. The Sacramento Peak Observatory vacuum tower telescope will be reconfigured to incorporate real-time adaptive optics. This represents a new era in solar observations. Acceleration mechanisms responsible for the transport of solar particles into the interplanetary medium will be investigated and efforts will be made to predict changes in the direction of the interplanetary magnetic field. These efforts are critical to the development of prediction tools for Air Force and Department of Defense space weather forecasters. Major alterations in the geomagnetic field during large magnetic storms increase the access of very energetic particles and cosmic rays in the polar regions. The study of these processes will provide new capability for specifying the effects of large, intense particle events on Air Force and Department of Defense microelectronics sensors. Dynamic global magnetospheric models will be developed and subsequently parameterized for transition to Air Force space weather forecasters. New sensors have been developed for the Air Force/Department of Defense space weather satellites which will expand our ability to predict space environments which cause spacecraft sensors malfunction or degradation. Theoretical studies and computer simulations of electron beam propagation and resulting wave generation, heating and optical signatures will be conducted. The celestial research on infrared signatures will be advanced through a data collection program from a mosaic array spectrometer.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: New AF Space Command and National Space Commands requirements will dictate new directions in space science research. The development of sensors and data acquisition techniques will lead to important new capability for understanding and monitoring the solar output and provide the data base for the next generation prediction algorithms. Instruments being developed through the Congressionally-mandated University Research Initiative on the measurement of solar vector magnetic fields will be completed and installed as a diagnostic at the Sacremento Peak vacuum telescope. The design of the next generation adaptive mirrors will be completed and fabrication will begin. The radiation dosage produced by galactic and solar cosmic rays will be determined for Air Force and Department of Defense space orbits. A unique data base generated through this research effort on high latitude precipitating particles and magnetic field-aligned currents will be

studied to develop models required by specifying magnetosphere/ionosphere transport mechanisms. Studies of solar radio emissions will be undertaken to advance the understanding of particle acceleration at the boundary between the interplanetary and magnetosphere regions. Interplanetary shocks will be investigated to determine whether they can be used to predict relationship between solar radio emissions and coronal mass ejections. Recently developed shock propagation models will be tested against new space data and new three-dimensional magnetohydrodynamic codes. The crucial problem of determining particle and energy transport mechanisms between the solar-interplanetary, interplanetary-magnetosphere and magnetosphere-ionosphere boundaries will be a major effort. Global models of substorm processes will be developed. Data from Space Division satellite sensors will provide data essential to the validation and verification of these models. The results consititute high priority products essential to survivable, reliable space operations. The efforts at transitioning these new models and data sets to Air Weather Service customers will be accelerated. The active space experiment effort will focus on the analysis of space data acquired during a rocket flight which had the objective of determining long distance transmission properties of energetic electron beams in space. These results are critical to establishing the feasibility of utilizing charged particle beams for offensive/defensive systems. A collaborative effort with the scientists involved in the European Space Agency Infrared Satellite Observatory will result in new high resolution angular and spectral infrared celestial data needed to interpret and define the operation of Air Force surveillance sensors.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

19. (U) PROJECT MORE THAN $10 MILLION IN FY 1989:

(U) Project: 2312, Biological and Medical Sciences

A. (U) Project Description: This research project provides knowledge needed to protect Air Force personnel and enable them to perform effectively in hostile environments. The project consists of three major research programs: (1) Biological effects of radiofrequency radiation and toxic chemicals are being studied to assess hazards to personnel and the environment and to devise protective measures; (2) Research in mechanisms of neuroregulation is being conducted to understand the biological bases of human performance and thus provide ways to enhance performance by, for example, reducing the effects of fatigue, jet-lag and diurnal rhythms; and (3) Research to develop computer architectures modeled after neuronal systems is aimed at providing powerful new approaches to machine intelligence.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) Recent advances in neuroscience promise ways to reduce the effects of stress on human performance. Neuroscientists have developed techniques to implant microelectrodes that monitor the electrical activity of neurons in alert, freely-behaving laboratory animals. Using these microelectrode techniques our investigators recently discovered neurons specifically activated by stressful situations. Further work to unravel the relationships among arousal, stress, sleep-wake cycles, fatigue, vigilance, and task performance will allow the

Air Force to design job tasks, schedule duties and train individuals to minimize the effects of stress and maintain alertness during prolonged missions. (2) A recent discovery may help protect military personnel from chemical and radiation hazards. Both toxic chemicals and ionizing radiation damage living cells by converting normal oxygen to toxic forms that interfere with cellular biochemistry. Air Force scientists recently found that 3-aminotyrosine inhibits toxic forms of oxygen, reducing cellular damage and inflammation caused by toxic chemicals or radiation. This discovery opens a path for better medical treatment of military personnel exposed to chemicals or radiation inadvertently or in wartime.

(2) (U) FY 1988 Program: Radiation and toxicology programs will continue research to devise better ways to protect personnel and the environment from hazards generated in Air Force operations. A new thrust will examine where toxic chemicals go when released at Air Force installations and their impact on ecosystems and human populations. Better ways to degrade spilled chemicals will also be examined. The neurobiology program will increase its emphasis on the role of neural regulation in arousal, vigilance, sleep/wake cycles, fatigue, stress, and other aspects of job performance. A joint initiative in neural and computer architectures for knowledge-based systems will involve the directorates of electronics, life sciences, and mathematics. Conventional computer architectures limit attempts to develop sophisticated artificial intelligence. Architectures are needed that allow extensive parallel processing rather than sequential operations, learning and self-programming by the machine, and tolerance to component failures. This initiative will support research on such nonconventional architectures. This research will include study of neural systems with the desired properties, and the information-processing mechanisms of humans as a model for intelligent machines.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new thrust is planned for research on subclinical cardiovascular disease in aircrews. Aircrew personnel are often grounded for subclinical cardiovascular irregularities, however the functional significance of these irregularities is poorly understood. In some cases aircrew personnel might be able to perform limited or even unlimited flying duties in spite of the irregularity. The USAF School of Aerospace Medicine, in collaboration with an academic medical center not yet determined, will start research to develop better ways to detect subclinical cardiovascular disease and to assess its functional significance. The toxicology program will continue to emphasize research on better ways to predict hazards from chemicals introduced into Air Force operations. The program will be extended to support research at the USAF Engineering Services Laboratory on developing bacteria to degrade toxic wastes. The neurobiology program will continue its emphasis on neural mechanisms that determine the capabilities and limits of human performance. It will also continue research in collaboration with other directorates to develop novel approaches to artificial intelligence based on the study of neural networks.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

20. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

50

(U) Project: 2313, Human Resources

A. (U) Project Description: This program provides the knowledge required to ensure that Air Force personnel can operate, maintain, and manage complex equipment systems in demanding environments. The major objectives are to improve selection of personnel for appropriate jobs on the basis of measured mental abilities and sensory-motor skills, designing equipment to match human information processing characteristics optimally, and monitor human workload and performance.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: (1) Humans quickly and easily learn to recognize the complex sensory patterns of vision, hearing and touch. A new theory of pattern classification recently developed can now be used to improve the computer's much poorer ability to learn these sensory patterns. This new theory, the Adaptive Resonance Theory, can be used to design computers with some of the abilities of humans to recognize patterns. The theory, based on human and animal research spanning several decades, is an important advance over previous models because it has the ability to learn through experience without a teacher, recognizes previously-learned patterns quickly without long memory searches, distinguishes new patterns not previously seen, and uses patterns already learned to form expectations of future events. (2) Computers designed to recognize speech have so far only a tiny fraction of human capabilities. Humans effortlessly handle the many different ways that a speech sound is affected by speaker identity, accent, and speaking rate. A new computational model of speech processing, the Auditory-Pereptuzl Model of phoneme perception, describes how computers might be designed to accurately recognize speech as strings of vowels and consonants. The model identifies complex features of the sound patterns of vowels and consonants that do not vary from speaker to speaker. This discovery should open a way to develop computers that do not have to be tuned to a single speakers voice.

(2) (U) FY 1988 Program: The initiative in Cognitive Aspects of Human Performance will reach full size. Air Force equipment systems have become so complex and the flow of information in tactical situations so rapid that the operator's ability to process information, make appropriate decisions, and act quickly is overwhelmed. One element of this program examines the ways in which skilled individuals, such as pilots, process information and make decisions under heavy workload. Mechanisms of attention, multiple-task performance, and memory are being studied. The Armstrong Aerospace Medical Research Laboratory and the Air Force Human Resources Laboratory will begin collaborative research as part of this initiative, examining how humans allocate mental resources to perform complex tasks in which several things must be accomplished in the same time frame. The extramural part of the program will be expanded to examine fundamental aspects of thinking, problem-solving, judgment, and decision-making in conditions of uncertainty. Another element of this new program examines individual differences to develop better tests of learning abilities. Air Force recruits are assigned to military occupational specialties partly on the basis of their scores on aptitude tests. Existing tests have limited power to predict aptitude for real-world jobs, but research in this field has not advanced dramatically until recently. This situation is now changing because of recent advances in our understanding of cognitive functions and through the use of computer terminals to allow adaptive testing of individuals rather than traditional paper and pencil tests. This initiative supports research collaborations between

leading university scientists and the Air Force Human Resources Laboratory, at which a major computer facility for aptitude testing has been developed. The program in auditory pattern recognition continues its emphasis on the mechanisms by which humans recognize complex auditory patterns. The vision research effort continues to study the mechanisms by which humans recognize objects, determine position and velocity of moving objects, and guide their own movements through the environment. Besides improving our understanding of human performance, these studies will open up ways to design machines capable of recognizing images and responding to speech.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The vision and auditory research programs will be expanded to include neurophysiological research approaches in addition to the psychophysical studies currently supported. Although the sensory nervous system has been the subject of much research, most of that research has focused on the early stages of visual information processing, because these stages have been the easiest to study. It is now possible to study later stages of visual processing, stages involved in the more complex aspects of perception such as recognition of objects. This is possible because of several advances: (1) more sophisticated techniques for recording the electrical activity of neurons, (2) better understanding of the organization of the sensory nervous system and (3) development of theories of information processing that can be tested by combining of neurophysiological and behavioral approaches to be far more powerful than either alone. The cognitive program will continue, with strong commitment to both Air Force laboratory and university research.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

21. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602101F — Title: Geophysics
DOD Mission Area: 522 - Environmental and Life Sciences (ED) — Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 37,552 | 35,832 | 34,838 | Continuing | N/A |
| 06GL | Laboratory Operations | 22,350 | 22,600 | 22,860 | Continuing | N/A |
| 3054 | Infrared Target and Background Signatures | 2,995 | 2,382 | 2,144 | Continuing | N/A |
| 4643 | Ionospheric Specification | 1,931 | 2,633 | 2,384 | Continuing | N/A |
| 6670 | Atmospheric Science and Technology | 1,474 | 966 | 982 | Continuing | N/A |
| 7600 | Terrestrial Geophysics | 821 | 714 | 659 | Continuing | N/A |
| 7601 | Space Effects on Air Force Systems | 4,272 | 3,692 | 3,246 | Continuing | N/A |
| 7659 | Aerospace Systems Technology | 608 | 675 | 623 | Continuing | N/A |
| 7670 | Optical/Infrared Properties of the Environment | 3,101 | 2,170 | 1,940 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This science and technology program develops the scientific groundwork required for countering adverse effects of the geophysical environment on the performance and operations of Air Force weapon systems. The focus is on advancing scientific knowledge and technology to support developers and users in improving missile guidance, air launch and recovery, target identification, space vehicle tracking, and satellite surveillance and communications. Just as most geophysics research and development is concentrated under Federal offices, geophysical research and development to support Air Force requirements is concentrated in the Air Force Geophysics Laboraory (AFGL) and supported through this program element. The breadth and depth of scientific effort at this laboratory results in extensive collateral support to non-Air Force and non-DOD programs and effectively make AFGL a national resource in geophysical research and development.

3. (U) COMPARISON WITH THE FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 38,259 | 39,523 | 42,436 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 and 1988 reductions reflect Congressional action and adjustments to the Air Force Total Obligation Authority. The FY 1989 reduction accommodates the reduction in the Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Etimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Military Construction: Funds | 0 | 0 | 530 | 0 | 530 |

5. (U) RELATED ACTIVITIES: This program benefits greatly from research in PE 0601102F, Defense Research Sciences. Major beneficiaries of the technology developed in this program are PE 0603410F, Space Systems Environmental Interactions Technology; PE 0603438F, Satellite Systems Survivability; PE 0603707F, Weather Systems (Advanced Development); PE 0102417F, Over-The-Horizon Radar System; PE 0604707F, Weather Systems (Engineering Development); PE 0603402F, Space Test Program; PE 0102431F, Defense Support Program; and PE 0305160F, Defense Meteorological Satellite Program. Programs in the broad area of geophysics are conducted by the Army, Navy, and federal agencies such as the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA). When applicable to Air Force requirements, information gathered by others is used in the Air Force program. In addition to such complementary programs, joint or coordinated programs are conducted with other agencies with mutual interests. We coordinate our research several ways: (1) in an annual tri-service review with the Office of the Under Secretary of Defense for Acquisition; (2) through the annual meeting of the NASA/AFSC Space Technology Interdependency Group; (3) with NOAA through committees of the Federal Coordinating Council for Science, Engineering and Technology and the Federal Coordinator for Meteorological Services and Supporting Research; and (4) through working groups (e.g., satellite meteorology) set up by AFGL. Coordinated and joint program success stories include a next-generation weather radar, a program with NASA to control undesirable electrical buildups on satellites, and an effort with Army and Navy to predict and overcome adverse atmospheric effects on several types of sensors in target areas.

6. (U) WORK PERFORMED BY: Work performed under this line item is conducted and managed by the Air Force Geophysics Laboratory, Hanscom AFB, MA. Five of the major contractors were: Emmanuel College, Boston MA (7601); Wentworth Institute, Boston MA (7670); Utah State University, Logan UT (3054); Systems and Applied Sciences, Vienna VA (6670); Boston College, Chestnut Hill MA (4643). In addition, approximately 85 other contractors are doing work totaling $18.0 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3054, Infrared Target and Background Signatures. Our work here responds to the Air Force's growing reliance on infrared sensors for surveillance, warning, and guidance. We're characterizing the infrared signatures of four natural backgrounds and nuclear earth and atmospheric backgrounds; we are also focusing on the signatures of targets within those infrared backgrounds. Using rockets, aircraft, balloons, and the Shuttle as measurement platforms, we gather data and compare actual data with theoretical and laboratory data. The results are then integrated into computer models to assist infrared systems designers, developers, and operators. In FY 1987, we rocketed an infrared measurement payload into an aurora of sufficient intensity to simulate a nuclear detonation. We also ran a

ground-based demonstration of a special, new type of infrared data collector, or interferometer. This new interferometer reduces the time required to collect data by using a focal plane array. By combining it with an optical Nutation device we can measure the infrared qualities of even such short-duration events as lightning and laser pulses. We will continue field experiments with this concept through FY 1989. Our 1987 work also included initiation of development of a stabilized, cooled optical telescope for airborne platforms. We hope such a device will let us detect dim and low observable targets at long range. Our FY 1988 work is concentrating on experiments with existing instruments on AFGL's flying infrared laboratory and with advanced sensors to support certain compartment classified programs. In FY 1989, we plan to initiate that work and deliver to Space Division two infrared clutter models for use by design teams. Funding constraints in FY 1989 will lead to termination of our advanced techniques work with sensors on the geophysics flying infrared laboratory--efforts were to have supported Strategic Air Command and Tactical Air Command in the areas of targets and backgrounds.

B. (U) Project: 4643, Ionospheric Specification. More and more Air Force systems operate in the ionosphere. This project develops the capability to predict, mitigate and exploit the effects of the ionosphere on these systems. Specific efforts include: (1) measuring the effect of D Region conductivity on Extremely Low Frequency/Very Low Frequency radio wave propagation, (2) specifying and predicting polar cap ionospheric irregularities that disturb high latitude communications and radars, (3) developing techniques to predict ionospheric characteristics that affect the performance of communication and surveillance systems such as over-the-horizon radar and survivable meteor burst communications, and (4) developing instrumentation and techniques for the Defense Meteorological Satellite Program to measure remotely the ionospheric electron density on a global basis. In FY 1987, our major rocket/aircraft groundbased program in Greenland provided the first analysis of ionospheric circulations of medium and large scale ionospheric structures generated at high latitudes and transported by polar cap electric fields into coverage regions of surveillance radars. We need those data to enhance the operational capability of high latitude missile warning radars. We developed computer codes to calculate the electron density profile from optical and other remote passive measurements for use on Air Force weather satellites. We initiated verification of the relationship between ultraviolet radiation and electron density using ultraviolet airglow measurements. We also made theoretical and experimental studies of ionospheric heating effects. In FY 1988, as solar activity and the associated high-latitude disturbances increase in frequency, we'll start a study on the survivability of high frequency conventional radio signals. We will finish the phase scintillation data base measurements program at high latitudes and use the results to predict systems outages. Ionospheric heating experiments will test the feasibility of creating artificial ionospheric mirrors for communications and surveillance programs. FY 1989 work will continue on a semiempirical model to predict communication outages due to phase scintillations on a global basis in near-real-time; this supports an Air Force precedence 1-1 customer and Air Weather Service for high solar activity years in late 1980s and early 1990s. We plan to develop a technique for oblique remote sensing of the electron density profile to support the over-the-horizon radar, meeting needs identified in MAC SON 02-80. This will enable Air Weather Service and the Defense Meteorological Satellite Program to meet identified operational requirements--strategic surveillance and warning and long-haul high frequency communications. Analyses of field results will produce recommendations for operationally releasable ionized gasses to reduce missile and aircraft engine radar cross sections. We will terminate ionospheric transionospheric scintillation work in support of the Ballistic Missile Early Warning System as well as ionospheric work which impacts on the meteor scatter common support to the Small Intercontinental Ballistic Missile program because of FY 1989 budget constraints.

C. (U) Project: 6670, Atmospheric Science & Technology. The Air Force requires new techniques to satisfy requirements for its ever expanding mission in support of emerging communications, surveillance, and acquisition systems technologies which the atmosphere impacts. This project develops capabilities for measuring, modeling, and predicting atmospheric properties. Current atmospheric global models can't provide adequate resolution for many operational missions. A thrust of this project is in smaller scale models which will provide required detail. During FY 1987 our high resolution rainrate data base was established. Cloud photographs taken from the Shuttle were used to model cloud size distribution and spacing needed to determine cloud free line-of-sights for laser communication and the infrared search and track system, which detects warm targets from above. Microwave imagery information for mapping meteorological parameters such as rainrate, ocean surface wind speed, and soil moisture were evaluated, and techniques for incorporating microwave imagery data into the cloud analyses program at the Air Force Global Weather Central were developed. During FY 1988, we will complete a rainrate duration model critical to extremely high frequency communications and an operational atmospheric dispersion model validation. Work will continue to incorporate microwave imagery data into the Air Force Global Weather Central cloud model, specifying global cloud structure. The work on global cloud forecasting will be slightly reduced in order to enhance efforts aimed at regional theater scale forecasting. A new program, Advanced Meteorological Processing System (AMPS) will develop forecast techniques for the base weather station by consolidating and integrating the many data displays soon to be available to the forecaster. A new effort will evaluate the capability of the ground-based radar wind profiler. During FY 1989 the cloud simulation model will be completed, and the atmospheric dispersion model will be turned over to the operational customer. The AMPS program and cloud analysis work will continue, using available satellite radar and conventional weather data. A new program will be initiated to investigate the capability of identifying and forecasting regions of potential induced lightning. A new program aimed at tropical storm forecasting, started in FY 1988, will be continued. Budget cuts in FY 1989 will eliminate efforts in lidar support for the defense meteorological satellite program as well as a high altitude balloon flight of an experimental laser lidar. We will also eliminate instantaneous rain rate duration models development critical to systems such as Joint Surveillance and Attack Radar System and terrain following/terrain avoidance systems.

D. (U) Project: 7600, Terrestrial Geophysics. This project, the only Department of Defense capability, measures and models the earth's geometry, gravity field, dynamics and motions to support Air Force strategic systems. Improved resolution and accuracy of global and missile launch region gravity models will be pursued through measurement and data analysis. Research will define--through field measurements and computer modeling--earth motion properties affecting Space Division's Space Transportation System, Ballistic Missile Office's Peacekeeper, Air Force Logistics Command's jet engine test facilities, and Tactical and Strategic Air Command operations. In FY 1987, we completed our development of methods for assessing the complete motion environment of possible Peacekeeper sites. We initiated an effort to develop a Superconducting Tensor Gravity Gradiometer (STGG) for potential application as an advanced inertial navigator in aircraft and missiles. A field program monitoring the seismic and acoustic ground loading caused by low level SAC overflights established the feasibility of using a seismo-acoustic network to augment acoustic detection methods in areas where radar capabilities are limited or can be circumvented. In FY 1988, we'll use mathematical techniques to analyze airborne gravity gradiometer test data and conduct seismo-acoustic studies to determine the environmental impact of lowering SAC low level overflights from 400 to 200 feet. The STGG will be constructed and will undergo electronic control and laboratory tests in FY 1989. Experimental seismo-acoustic networks will be developed and implemented under controlled low level flight conditions for enhancement of acoustic detection system for use in detecting stealthy

targets. Reduced budgets in FY 1989 will cause us to cancel seismological research critical to Strategic Air Command's low level flights and to the Ballistic Missile Office for missile basing concepts.

E. (U) Project 7601, Space Effects on Air Force Systems. The project develops technology to: (1) increase the reliability/survivability of Air Force space systems through the mitigation of particle, radiation, and contamination effects, (2) quantify/model satellite signatures and phenomenology for sensor systems applications, (3) predict space weather for military man in space, and (4) exploit the space environment as a medium for strategic and tactical military operations. The program measures, models, and forecasts the space radiation environment (solar, interplanetary, magnetospheric region) phenomena resulting from spacecraft interacting with the space environment and spacecraft contamination. Satellite, rocket, Shuttle, and ground-based experiments combined with theory, provide dynamic computer based models tailored to application for spacecraft design. In FY 1987, we developed a molecular contamination model to characterize the flow of neutral gas molecules onto sensitive space-based sensor surface/windows. The particulate contaminant data base was provided to the ASAT SPO for system application. Fifteen space radiation instruments were integrated on the Combined Release Radiation Effects Satellite (CRRES), for which a 1990 launch was negotiated with NASA. The first climatological maps of precipitating ions into the high latitudes showed that ions produce large global energy inputs and can have a major impact on communications and surveillance operations. We also established the feasibility of producing energetic electron accelerations in the magnetosphere by ground-based high powered radio frequency waves. In FY 1988, we'll launch an ECHO-7 rocket to assess long distance propagation of high current electron beams. Imagery experiments from the Air Force Maui Optical Site will help us quantify optical contaminant effects around orbiting spacecraft. A new initiative will be undertaken to develop state-of-the-art energetic particle, space plasma, field, and wave detectors. In FY 1989, we'll deliver the Space Radiation Effects Program/CRRES sensor to the spacecraft integrator. Dynamic magnetospheric models will transition to Space Command and Military Airlift Command's Air Weather Service (a high JCS priority). Particle and field detectors developed for operational spacecraft will provide crucial data for validation of space weather models and for real-time space operations. Shuttle-based optical experiments will quantify the Shuttle surface glow for application to space object identification/mission assessment phenomenology supporting AFSPACECOM.

F. (U) Project: 7659, Aerospace Systems Technology. This project has the only Department of Defense (DOD) high altitude balloon capability in the United States. This capability improves the usefulness of the spacecraft, balloon, and sounding rocket payload systems used as experiment carriers by Air Force Geophysics Laboratory and DOD. The work is focused on applying modern technology, particularly microelectronics, in developing experimental sensor platforms and efficient data management techniques. In FY 1987 developmental testing was completed on an experimental payload-support system (controller, data-encoder/logger, and powers) for "getaway special" experiments to be flown on the Shuttle. A simplified balloon navigation system using the Global Positioning Satellite system was designed. In FY 1988, final testing will be conducted on a system which adapts a commercial laser disk recorder for high-rate pulse-code-modulated telemetry data. This cost-effective system is effective for recording large quantities of high-bit rate telemetry data. In FY 1989, we'll complete testing of the balloon navigation system and use it for our experimenters for precise balloon tracking. FY 1989 funding constraints will force us to reduce this program to a maintenance level. Efforts to improve state-of-the-art telemetry, data storage, positioning, guidance, and tracking will stop. Future experimental payloads will be impacted.

C. (U) Project: 7670, Optical/Infrared Properties of the Environment. This project develops: (1) lidar technology to measure atmospheric properties from space, (2) models and tools to predict the impact of the atmospheric environment on DOD weapons and surveillance systems, and (3) models, data base, and scene generators of the celestial space background for surveillance and tracking systems used to find and track space vehicles. In FY 1987, we completed a point source celestial background model and started development on the diffuse celestial background that can appear as a false space target. The design study for the lidar sounder for the Defense Meteorological Satellite Program Block 5D-2 spacecraft was also completed. A successful flight of a balloon-borne lidar to simulate lidar returns from a space platform was completed. We also completed a program to demonstrate that sub-visual cirrus clouds should not reduce the acquisition range of the Infrared Search and Track system by using a B-52 target and the AFGL airborne infrared imaging systems along with numerous lidars, airborne samplers, and ground observations. Results of two field measurement programs, one in clear air and the other in optically thin scattered cirrus substantiated this conclusion. In FY 1988, we'll complete the atmospheric transmission code, LOWTRAN7. This code will be marketed by private companies through cooperative R&D agreements as permitted under the Federal Technology Transfer Act of 1986 through the license agreement, thereby assuring the DOD community the AFGL standards-of-excellence in the product they purchase. We'll fly a raman balloon-borne lidar to demonstrate the capability to measure stratospheric water vapor. A doppler lidar to measure wind speed and direction will be completed and deployed in a mobile van. In FY 1989, an automatic, self-sensing algorithm for an infrared sensor to correct for atmospheric limitations on ranging and imaging on smart weapons will be tested. The lidar technology will be pushed to develop an eye-safe lidar for wind sensing from space. The celestial background measurements will occur with the Visual Photometric Experiment on the shuttle. We will cancel our FY 1989 atmospheric data definition work in support of additional sensors for Tactical Decision Aids because of funding. This will impact the efficient use of smart electrooptical guided weapons systems.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06GL, Laboratory Operations

A. (U) Project Description: This project supports and complements all other projects in this program element and provides for management, support, and operation of the Air Force Geophysics Laboratory, Hanscom AFB MA and its operations at four widely dispersed research locations stateside. It provides for the pay and related costs of civilian scientists, engineers, and support personnel; transportation of equipment, rents, communications and utilities costs, duplication and reproduction services and procurement of supplies, equipment, and contractor support services for maintenance and modification of facilities. The Air Force Geophysics Laboratory performs research and exploratory development in the geophysical sciences--geodesy, gravity, meteorology, optical physics, ionospheric physics, upper atmosphere physics, infrared backgrounds, and space physics--in support of immediate or potential needs of Air Force operational systems. Static funding for this project in FY 1989 will force us to cut back on our computer analysis and vendor upgrades to operational software and to terminate a contract for algorithm data reduction.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602102F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Materials
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 54,290 | 54,856 | 58,367 | Continuing | N/A |
| 06ML | Laboratory Operations | 15,043 | 16,076 | 16,841 | Continuing | N/A |
| 2417 | Thermal Protection Materials and Structures | 4,005 | 4,050 | 4,500 | Continuing | N/A |
| 2418 | Metallic Structural Materials | 11,168 | 10,200 | 11,300 | Continuing | N/A |
| 2419 | Nonmetallic Structural Materials | 6,910 | 6,034 | 6,350 | Continuing | N/A |
| 2420 | Aerospace Propulsion Materials | 3,827 | 4,205 | 4,726 | Continuing | N/A |
| 2421 | Fluids, Lubricants and Elastomeric Materials | 3,603 | 3,575 | 3,985 | Continuing | N/A |
| 2422 | Protective Coatings and Materials | 3,720 | 4,128 | 4,600 | Continuing | N/A |
| 2423 | Electromagnetic Windows and Electronic Materials | 6,014 | 6,588 | 6,065 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program contains the entire Air Force Exploratory Development program in materials. It develops new materials which are required to meet the increased performance, reliability and survivability demands of current and future aerospace systems. The needs of Air Force aircraft, spacecraft and missiles are specialized and unique and cannot be satisfied solely by research and development programs sponsored in the private sector. The program also provides management and operational support for the Materials Laboratory, Wright-Patterson Air Force Base, OH, as the Air Force agency concerned with all aspects of materials research, development and manufacturing technology.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 50,948 | 62,676 | 63,064 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 increase in funding is due to reprogramming of funds to support a high priority Air Force program. The FY 1988 reduction is due to Congressional action. FY 1989 accommodates an Air Force Total Obligation Authority reduction. These reductions will cause delays in the transitioning of advanced materials into Air Force weapons systems.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: All three military services, the Defense Advanced Research Projects Agency, the National Aeronautics and Space Administration, the Department of Energy, and industry carry out research and development programs

in materials technology. Coordination is provided by the exchange of planning documents, joint agency technical planning committees and activities such as the Department of Defense Metal-Matrix Composite Steering Committee, the Joint Directors of Laboratories Advanced Materials Panel, and the Tri-Service Laser Hardened Materials and Structures Group. These joint planning meetings and materials coordination activities highlight the specialized material requirements of each organization and are determining factors in the formulation of complementary, nonredundant materials research and development programs. This program element receives specific input from PE 0601102F, Defense Research Sciences. This program element provides technology for further development to other program elements such as PE 0602203F Aerospace Propulsion; PE 0603211F, Aerospace Structures and Materials; PE 0603202F, Aircraft Propulsion Subsystems Integration; PE 0603216F, Aerospace Propulsion and Power Technology; and PE 0708011F, Manufacturing Technology.

6. (U) WORK PERFORMED BY: The Materials Laboratory of the Wright Aeronautical Laboratories, Wright-Patterson AFB, OH, manages the program. The top five contractors in FY 1987 were: University of Dayton, Dayton, OH (2417, 2418, 2419, 2420, 2421, 2422, 2423); General Electric Company, Cincinnati, OH (2417-2420); Illinois Institute of Technology, Chicago IL (2420, 2422); United Technologies, West Palm Beach, FL (2418, 2419 and 2420); and Rockwell International Corporation Thousand Oaks, CA (2418, 2419, 2420, 2422, 2423); representing a contract value of $70,470,000. There are 71 additional contractors and the total contract value for contracts active in FY 1987 was $172,470,000.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2417, Thermal Protection Materials and Structures. Provides new materials and processes for thermal protection of Air Force systems and components exposed to intense heat, mechanical stresses, and erosive environments. High performance materials technology is emphasized for future uses on military gas turbine engines, solid rocket and space engine propulsion systems, strategic reentry and penetration systems such as the maneuverable re-entry vehicle (MaRV), space structures and high Mach number aerodynamic vehicles. Emphasis is on improving the performance of carbon fiber reinforced carbon matrix composite materials. These materials are the most promising available for maintaining acceptable strength at very high temperatures. High temperature dielectric (nonconductive) materials such as nitride/silica based materials are being developed for reentry system antenna windows. FY 1987 accomplishments include: successfully tested underground an x-ray resistant decoy coating; demonstrated and transitioned decoy nosetips to an advanced reentry system; confirmed reduced fuel consumption during testing of an advanced cruise missile engine coated carbon-carbon combustor; identified coatings for ultra high temperature (UHT) carbon-carbon compsites which resulted in a 10 percent lower density than state-of-the-art carbon-carbon; and demonstrated a hybrid fiber, 2-D composite with 50 percent higher interlaminar shear strength. FY 1988 Milestones include: completion of oxidation resistant, stable fiber program, shear test methods program; extended life coating program; and the nosetip, dielectric heatshield and x-ray resistent coatings programs for advanced decoys. Technologies to be continued are the screening of UHT composite materials, oxidation and mechanics of high temperature composites, processing science for advanced resins, development of materials and processes for structural carbon-carbon for space aerostructures and advanced low observable reentry materials. Initiated a program to investigate innovative intermediate temperature oxidation protection concepts for carbon-carbon fibers. FY 1989 includes: initiation of an UHT composite concept evaluation program; identification of intermediate temperature, oxidation resistant carbon-carbon with 100 percent increase in structural properties and over 500 hour reproducible life time; initiation of a manufacturing science program for carbon-carbon; definition

of mechanisms to increase cross ply properties of 2-dimensional composites; establishment of structural limitations of thin, stiff carbon-carbon space structures; and definition of re-entry vehicle material concepts for penetration assistance. These efforts are required to continue development of high temperature, light weight material for maneuverable re-entry vehicles, high Mach air vehicles, and high performance turbine engines.

B. (U) Project: 2419, Nonmetallic Structural Materials. This project provides new organic and carbonaceous materials having combinations of properties suitable for use over the temperature range from cryogenic to 3000°F for structural applications in Air Force subsonic and supersonic aircraft, satellites, and missile systems. It includes development of fibers, ordered polymer films and molecular composites for application in improved structural materials, and development of radar signature reduction materials for enhanced survivability. Continuing emphasis will be placed on developing organic matrix composites with increased strength, stiffness, temperature capability and durability along with reduced weight and cost. These material enhancements may be achieved in both thermosetting and thermoplastic organic matrix composites. The newer technology thermoplastic composites soften and become formable and are more ductile than the thermosetting composites (such as conventional graphite reinforced epoxy). Thermoplastics offer additional benefits of decreased production costs and increased durability. FY 1987 accomplishments: Resin/fiber development efforts based on acetylene terminated resin technology have been successfully completed. Moisture resistant, 450°F resins were formulated. These materials have been supplied to several different aircraft primes for their evaluation; the successful transition to industry of ordered polymer fiber technology has been completed. A major chemical firm has announced plans to commercially produce an organic fiber based on ordered polymer technology developed within this project. This fiber has demonstrated significantly improved properties over the best grades of aramid fibers. Research was initiated to significantly reduce the cost of processing molecular composites; approaches such as in-situ rods and the use of less aggressive solvents are being pursued. Efforts were initiated to improve the compressive properties of fibers derived from ordered polymer systems; modest improvements in compressive strength would significantly impact the structural efficiency of these fibers and result in substantial weight savings. The use of ultrasonic energy to reduce processing temperatures of thermoset and thermoplastic composites was successfully demonstrated. The viability of this approach for commercial applications will be vigorously investigated. FY 1988 plans: Continue development of advanced thermoplastic composite processing methodologies that will provide a significant reduction in acquisition costs. Processes such as the use of hot-heat tape laying and laser heating will be investigated; methods for increasing the compression strength of ordered polymer fibers will continue to be explored. Efforts under the ultra-lightweight materials initiative will be yielding preliminary results that will point the way for further activities. Processing methodologies for fabricating molecular composites will continue to be explored with the goal of significantly simplified processing. This will allow an initial assessment of the potential of molecular composites as a structural alternative to conventional composite materials. FY 1989 Program: A preliminary assessment of the potential role of biotechnology in the processing and performance of high performance matrix materials and composite structures will be made. An area of poetential cost savings is aircraft paint removal. The development of processing models and advanced processing procedures for thermoplastic composites will be completed. We plan to define the potential of carbon-carbon composite materials for structural applications to 1800-3000°F. An expert system that will cure composites by an artificial intelligence approach will be demonstrated. Work will continue on the supportability of thermoplastics and the modelling of unit processes. Activities directed at improving the compression properties of ordered polymer fibers will be completed. Work will continue on the development of molecular composite processes and

properties and on ultra lightweight technology. An initial assessment of the potential of newly emerging materials to significantly reduce aircraft weight will be completed. Work in this area must continue to support development of lightweight structural materials for Air Force aircraft, missiles, and communications/surveillance satellites.

C. (U) Project: 2420, Aerospace Propulsion Materials. Provides new and improved materials and manufacturing processes for components for advanced air-breathing propulsion systems for both aircraft and missiles in direct support of the DOD Integrated High Performance Turbine Engine Technologies (IHPTET) initiative. This initiative has the potential to double the thrust-to-weight ratio of a turbine engine. Benefits will be more capability to operate in the high temperature oxidizing environment of a gas turbine engine, reduced life cycle costs, increased performance, and reduced fuel usage. This requires new materials/processes to provide lightweight, extremely high operating temperature, uncooled components with full service lives; an additional benefit will be reduced dependence on critical raw materials from foreign sources. Major developmental efforts are directed toward composite materials based on titanium aluminides ceramics, high temperature intermetallics and refractory metals. FY 1987 accomplishments include: completion of development of short crack behavior technology applicable to titanium/aluminide (TiAl) characterization; transition of fracture mechanics "retirement-for-cause" methods for turbine engine components to operational commands to gain a large life cycle cost savings for all major engines; continuation of characterization of fatigue/fracture properties of TiAl and their composites; continuation of development of reinforcement technology for high temperature (1800-3000°F) ceramic composites; initiation of exploratory development efforts to formulate and evaluate nickel aluminide based alloy compositions, as well as other very high temperature intermetallics; development of materials for oxidation resistant columbium alloys for extreme high temperature use; and undertaking an effort to devise improved computer-aided materials manufacturing, based on theoretical work accomplished for TiAl. FY 1988 program includes: significant enhancement of the High Temperature Metals and Ceramics efforts initiated under the IHPTET. This includes initiation of advanced intermetallic composite feasibility program to identify approaches for new materials in the 2000-3000°F temperature range; characterization of TiAl composite mechanical behavior including environmental effects and damage tolerance concepts; and identification of candidate ultra-high temperature composite materials. FY 1989 program include: identification of specific approaches to develop ultra-high temperature (UHT) ceramic composites to meet IHPTET goals based on completed feasibility studies and engine requirements; initiation of effort to define relation between microstructure and processing variables in TiAl; fabrication of first generation TiAl (gama) composites; investigation of the feasibility of advanced intermetallic composite materials for use in the 2000°F-3000°F temperature range; damage tolerance concepts work for the application of TiAl composites to IHPTET applications will continue as well as the investigation of the effects of environment on the fracture behavior of $Ti_3Al$ composites; development of test techniques for evaluating tensile behavior of ceramic matrix composites at temperature greater than 3000°F. Research in this area must continue to support development of high performance, lightweight turbine engines.

D. (U) Project: 2421, Fluids, Lubricants and Elastomeric Materials. This project develops advanced materials and technology for fluids, lubricants, energy transfer fluids, seals, and advanced fluid containment systems required for use in aircraft propulsion and hydraulic systems, spacecraft and missile propulsion systems and spacecraft attitude control. Nonflammable and low-temperature fire resistant hydraulic fluids will be developed as well as lubricants and seals for gas turbine engines, and explosion suppression foams for fuel systems. FY 1987 accomplishments include: formulation of candidate -65 to 275°F nonflammable hydraulic fluid (NFHF) and candidate compatible hydraulic system

seals; completion of hydraulic pump validation of candidate nonflammable hydraulic fluid (NFHF) as well as validation by component and systems designers; completion of dynamic seal validation tests of candidate seals for NFHF at temperatures up to 275°F and pressures up to 8000 psi; successful development of a polyolefin based -65 to 275°F fire resistant hydraulic fluid for use in current aircraft that were unable to convert to MIL-H-83282, fire resistant hydraulic fluid; development of a hydrolytically stable dielectric coolant for use in current and future radar and other high energy electronic systems; development of a long life, water resistant grease for the cruise missile engine bearing which permits extension of engine overhaul time from 30 to 60 months; developed a new, major research program on liquid lubricants and seals for Integrated High Performance Turbine Engine Technology (IHPTET); developed and transitioned an explosion suppressant foam material for aircraft fuel tanks; development of elastomeric lens for chemical biological warfare (CBW) defense mask. These accomplishments support development of aircraft safety methods and advanced engines and airframes. FY 1988 program includes: completion of 400°F fuel lubrication seal material development for application in advanced high temperature turbine engines; continuation of development of -65 - 350°F nonflammable hydraulic fluid and compatible seals capable of operating at pressures of up to 8000 psi; initiate research and development program to develop very high temperature gas turbine engine oils for IHPTET; a completely tested 400°F gas turbine engine oil will be transitioned into service to replace the currently used military standard engine oil, MIL-L-7808. FY 1989 program includes: completion of work on a 350°F conductive explosion-suppression foam; the fundamental technology base for solid lubricated ceramics will be completed; and development of a -65 - 225°F fire resistant silahydrocarbon hydralic fluid will be completed; continue work in the molecular modelling area to support the development of very high temperature liquid lubricant needed for the IHPTET technology program. Work in this project is required to insure safe, high performance fluids, lubricants and elastomeric for applications in high Mach vehicles and engines.

E. (U) Project: 2422, Protective Coatings and Materials. This project provides materials and concepts to enhance survivability of aircrews and vital components of Air Force aircraft, missile and communication/surveillance satellites in natural and weapon threat environments. Although related to the materials needs identified in other projects in PE 62102F, materials considered in this project primarily have a protective function essential to the survival of the crew, avionics, and other critical subsystems of the military systems. Space system materials development includes survivable thermal management (coating) materials which reduce the problem of contamination of spacecraft surfaces while enhancing life and survivability. Aircraft and missile system materials efforts are directed toward development of vehicle camouflage (visible band), and observables reduction in nonvisible bands. Multiple laser hardening optical concepts such as filtering, switching, and limiting are being developed for hardening of strategic and tactical systems and components, including personnel. In FY 1987 accomplishments include: development of spacecraft radiator coatings and insulation materials hardened against ground based lasers and nuclear weapon effects; development of a personnel protection visor which is being directly transitioned to the Life Support System Program Officer of Aeronautical Systems Division; the Forward Looking Infrared hardening technology is being directly transitioned to the Maverick System Program Officer (SPO) of Aeronautical Sytems Division; continued materials testing to meet spacecraft outgassing/condensation criteria established in FY 1985; continuation of development of spacecraft radiator coatings hardened against space based lasers; identification of candidate switch/limiter materials concepts to protect against multi-wavelength agile lasers; demonstration of rugate filters for visible and infrared wavelength rejection; completion of spacecraft materials contamination characterization; demonstration of mobile notch filters for multi-wavelength laser protection; and availability of nonlinear polymers of switch/limiter laser protection developments. FY 1988

program includes: completion of spacecraft materials contamination characterization enabling extended on-orbit life of future satellites; completion of survivable thermal control coatings development which will enhance the survivability of large spacecraft radiator surfaces under laser or nuclear attack; complete the development of thermal flash coatings meeting the requirements of the Strategic Air Command Statement of Need 008-86, "Thermally Resistant Aircraft Camouflag Coatings" and the needs of MILSTAR airborne and ground terminal radomes; demonstration of solid state multiple wavelength filters enabling protection of electro-optical systems and personnel from multi-wavelength lasers; continuation of the development of spacecraft radiation coatings hardened against space based lasers; continuation of development of lasers/nuclear hardened multi-layer insulation spacecraft blanket materials; continuation of the efforts to develop organic nonlinear optical materials; and initiation of efforts to develop superlattice structures (multi-layer semiconductor material) for laser hardening applications. FY 1989 program includes: complete exploratory development work on nonlinear organics for the protection against agile/pulsed laser threats; complete the development of advanced thermal flash coatings technology and transition optimized thermal flash coatings to the Strategic Air Command and the MILSTAR program; advanced thermal control coating will be transitioned to Space Division; development will continue in multi-threat survivable spacecraft coating and in superlattice hardening technology for advanced laser threats; demonstration of stabilized colloidal array filters exhibiting linear and nonlinear optical properties for laser protection of electro-optical devices; and demonstration of prototype superlattice devices for laser hardening applications. These efforts need to be continued to ensure survivable advanced Air Force tactical and strategic weapons systems.

F. (U) Project: 2423, Electromagnetic Windows and Electronic Materials. This project develops materials and materials processes for optical, electromagnetic, and electronic subsystems for Air Force aircraft, missile and satellites systems. These materials are required for application to a broad range of electromagnetic and electronic devices and components critical to system operation in natural and weapon threat environments. Present emphasis is to develop high performance infrared detector materials for strategic and tactical detector arrays; high purity, low defect gallium arsenide crystals for monolithic microwave integrated circuits essential for development of advanced airborne radar; nonlinear optical materials for optical correlation, integrated optics, electro-optic countermeasures and laser communications; and electronic packaging technologies essential for development of reliable very large scale integrated circuits components/systems. FY 1987 accomplishments include: development of a lower cost, vapor phase deposition process for epitaxial mercury cadmium telluride detectors; development of analytical model to predict detector performance improvements as a function of impurity reduction in extrinsic silicon; development of growth parameters for reproducible fabrication of superlattice and quantum well detector devices; reduction of dislocation density in bulk GaAs crystals by 2 orders of magnitude through indium alloying and control of thermal gradients; initiation of efforts to develop technology for growth of nonlinear ferroelectric thin films for optical correlation devices; and fabrication and rain erosion tests of full scale broadband ablative radomes for tactical air-to-air missiles. FY 1988 program includes: initiation of an effort to optimize metal-organic chemical vapor deposition growth processing for large, uniform epitaxial layers of mercury cadmium telluride for infrared detectors; continuation of efforts to model and optimize the growth of detectors utilizing superlattice and quantum well technologies for strategic and tactical surveillance/imaging applications; continuation of work to achieve higher purity gallium and arsenic as starting materials for gallium/arsenide (GaAs) bulk crystals; continuation of the development of higher purity metal-organics for epitaxial growth of GaAs; development of an advanced gallium arsenide processing model; completion of the development of more reliable reduced cost tailorable coefficient of thermal expansion printed wiring board systems; initiation

of work to develop nonlinear optical materials for frequency agile lasers and electro-optic countermeasures; initiation of in-house modelling and molecular beam epitaxial growth of compound semiconductor thin film ultra-structures with applications to nonlinear optical devices and detectors; initial operational capability of inhouse nonlinear optical materials development and characterization laboratory; completion of the development of more reliable solder process for very large scale integrated circuits. FY 1989 program includes: completion of initial efforts to establish applicability of superlattice and quantum well structures for long wavelength infrared detectors; continued superlattice detector materials development with emphasis on photo-assisted and gas source molecular beam epitaxy; completion of assessment of impact of indium doping of gallium arsenide (Ga/As) wafers on microwave device yield and continued work GaAs materials for higher frequency; continued development of Ga/As growth technologies; initiation of an effort to scale-up molecular beam epitaxial growth technology to process multiple wafers; selection of the optimum growth technique for ferroelectric thin films and initiation of follow-on optimization efforts for nonlinear optical applications. Work in this area must continue to develop electronic materials to support future tactical weapon systems and surveillance systems.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2418, Metallic Structural Materials

A. (U) Project Description: This project provides reliable advanced metallic materials and processes with optimum combinations of properties from cryogenic temperatures to 1800°F for potential use in tactical and strategic aircraft structures, turbine engines and missiles. Special emphasis is on rapid solidification technology (RST), powder metallurgy for aluminum and titanium alloy development, and metal matrix composites. A goal of 1800°F service temperature established for RST titanium alloys is approximately a 700°F increase in capability and will allow the use of lower cost, easier to work structural materials, which provide a 40 percent weight reduction over superalloy, for design of future Air Force aircraft systems. This project provides the preliminary engineering data to assist in the transition of emerging structural materials from the laboratory to aerospace applications. It also provides for development of the advanced technologies required to increase productivity for future Air Force manufacturing and maintenance processes. It also provides the development and breadboard feasibility demonstration of advanced Non-Destructive Inspection and Evaluation technology for quality and integrity assurance of aerospace materials and structures in support of the life cycle engineering effort.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 accomplishments: initial characterization of crack propagation for corrosion resistant high strength powder metallurgy aluminum; development of scaleable processing to convert aluminum powder to a full-range of high temperature resistant product forms without mechanical property loss; completion of an evaluation of a potentially high production rate process for providing large quantities of contamination free rapidly solidified titanium powder; concepts identified to potentially extend the useful service temperature of aluminum-base materials up to 900°F and titanium-base materials as high as 1800°F; characterization of low density powder metallurgy aluminum-lithium alloys completed; evaluation of concepts for development of ultra-lightweight magnesium-base alloys initiated; evaluation of

dispersion strengthened rapidly solidified titanium alloys for 1300°F service completed; initial characterization of damage tolerant aluminum castings completed; demonstrated effective carbon-carbon computed tomography (CT) data and structural analysis codes to predict carbon-carbon composite component failures; experimental verification of Non Destructive Inspection/Evaluation (NDI/E) system concept to rapidly inspect large scale composite components; development of unique ultrasonic method to produce ply-by-ply images of delaminations in organic matrix composite materials.

(2) (U) FY 1988 program: Efforts planned for completion include: characterization of crack propagation in high strength and high temperature rapidly solidified aluminum powder metallurgy alloys; initial development of ultra-lightweight magnesium-based alloys with high strength and corrosion resistance; initial development of processing of metallic foils for flare applications; processing development for aluminum powder alloys scalable to very large sizes and a full range of high temperature resistant product forms with no property loss; development of concepts and alloys synthesis strategy for 900°F aluminum-base and 1800°F titanium-base materials; development of methods to allow use of damage tolerant aluminum alloy castings in structural applications; feasibility study of nuclear magnetic resonance (NMR) methods to inspect composite materials; demonstrations of new NDI/E tools for in-situ monitoring of the composite curing cycle, development of phase-insensitive ultrasonic transducer concept and thermal wave imaging method to detect minute surface cracks; development/demonstration of ultrasonic methods to detect microporosity in premium aluminum castings; development of laser-based ultrasonics techniques to characterize elastic properties in ceramic composites; development/applications studies for ultrasonics and eddy current method reliability prediction models. New initiatives include: new NDI/E techniques to characterize advanced materials microstructure/features; application studies on new powerful x-ray CT techniques (dual energy, laminography, microscopic imaging); development of thermal wave imaging crack detection procedures.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funding is required to complete the following: definition of practical limits of thermal stability in high temperature resistant aluminum and titanium alloy and engineered materials; initial synthesis and development of 900°F aluminum alloys and metal matrix composites and appropriate rapid solidification processing in support of Integrated High Performance Turbine Engine Technology (IHPTET); initial synthesis and development 1800°F titanium-base materials and processing in support of IHPTET; initial development of ultra-lightweight high strength, corrosion resistant magnesium-base materials; initial development of methods to produce damage tolerant titanium alloy structural castings to allow implementation with no casting factor; develop high temperature protective coating NDI/E methods and ultrasonics/eddy current methods reliability prediction models and methods to map elastic properties of ceramic-matrix composites; investigation of metal bondline NDI/E techniques; transition of new x-ray computed tomography (CT) technology to PE 63211F. Funding is required to continue work in: the development of advanced alloys based on the results of the initial synthesis; advanced structural materials property nondestructive characterization; exploration of advanced x-ray CT applications; refinement of methods reliability modelling for specific real designs, and new imaging analysis methods applied to NDI/E. Funding is also required to initiate work in: nuclear magnetic resonance methods applications to advanced engine material; and advanced corrosion detection methods. Programs in this project are required to assure adequate lightweight, high strength, temperature resistant metals are available for future USAF aircraft, missiles, engines and satellites.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06ML, Laboratory Operations

A. (U) Project Description: This project provides for management and support of the Materials Laboratory and includes the pay and related costs of civilian scientists, engineers and supporting personnel, travel, transportation, rents, communications, utilities costs, procurement of supplies and equipment, and contractor support services. It also funds salaries, travel, and equipment for personnel at Aeronautical Systems Division providing procurement support to the laboratory. The Materials Laboratory is responsible for the Air Force exploratory and advanced development programs in the area of materials technology, a portion of the basic research program in materials, and for administrative support of the Air Force Manufacturing Technology program.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602201F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Aerospace Flight Dynamics
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 70,861 | 67,698 | 69,269 | Continuing | N/A |
| 06FF | Laboratory Operations | 33,909 | 32,578 | 31,879 | Continuing | N/A |
| 2401 | Structures and Dynamics | 9,660 | 9,131 | 10,235 | Continuing | N/A |
| 2402 | Vehicle Equipment | 6,600 | 6,321 | 6,381 | Continuing | N/A |
| 2403 | Flight Control | 9,608 | 9,131 | 10,235 | Continuing | N/A |
| 2404 | Aeromechanics | 9,238 | 8,780 | 8,783 | Continuing | N/A |
| 3038 | Technology Integration and Assessment | 1,846 | 1,757 | 1,756 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program provides the flight vehicle technologies required for the design and development of future aerospace vehicles (aircraft, missiles, and spacecraft) and for the improvement of current vehicles. It encompasses the technical areas of structures, aerodynamics, flight performance analysis, vehicle dynamics, crew station design, environmental control, mechanical subsystems, survivability/vulnerability, and technology integration and assessment. The program also provides for the management and support of the Flight Dynamics Laboratory, Wright-Patterson AFB, OH.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 65,826 | 70,087 | 72,059 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 increase was a result of reprogramming of Air Force S&T dollars for a higher priority program. FY 1988 differences are due to Congressional reductions. The FY 1989 decrease is a result adjustment in the Air Force Science and Technology investment strategy.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This program receives technology inputs from In-house Laboratory Independent Research (PE 0601101F), Defense Research Sciences (PE 0601102F), Materials (PE 0602102F), and Aerospace Biotechnology (PE 0602202 as well as from other national and international research and development activities. In turn, the technology product of this program is applied to Flight Vehicle Technology (PE 0603205F), Aerospace Structures and Material (PE 0603211F), Crew Systems Technology (PE 0603231F), Advanced Flight Technology Integration (PE 0603245F), Variable

Stability In-Flight Simulator Test Aircraft (PE 0604237F), and other advanced, engineering, and system development programs. Cooperative and jointly funded projects are conducted with other Air Force organizations, the Army, the Navy, the National Aeronautics and Space Administration, and foreign countries. Coordination and avoidance of duplication of effort is accomplished through exchange of information, coordinating and advisory groups, technical reviews and seminars, professional societies meetings, and through the preparation of technical reports.

6. (U) WORK PERFORMED BY: This program is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. The top five contractors are Boeing Co., Seattle, WA (2401, 2402, 2403, 2404); General Dynamics Corp., Ft Worth, TX (2401, 2403, 2404); Lockheed Aircraft Co., Burbank, CA (2401, 2402, 2404); McDonnell Douglas Co., St. Louis, MO (2401, 2403, 2404); and Northrop Corp, Hawthorne, CA (2401, 2402, 2404). The total number of additional contractors is 88, with a total contract value of $78.0 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2402, Vehicle Equipment. This project develops the technological base and demonstrates new capabilities in: (1) flight vehicle ground mobility, takeoff and landing systems; (2) transparent crew enclosures; (3) cryogenic cooling; (4) aircraft environmental control; (5) flight vehicle vulnerability; (6) emergency crew escape; (7) robotics for aircraft ground servicing and maintenance; and (8) reliability assessment and technology. The goals are to reduce the life cycle cost of subsystems and equipment, increase the probability of flight vehicle and crew member survival, and improve flight vehicle operational capabilities. In FY 1987 a tri-cell air cushion equipment transporter capable of moving tactical aircraft and heavy equipment of up to 65,000 pounds over rough and soft terrain was developed, and its performance characteristics were evaluated over a variety of terrain conditions. The transporter was transitioned to the Aerospace Maintenance and Regeneration Center (AMARC), Davis-Monthan AFB, AZ, where its operation was successfully demonstrated by moving F-4 aircraft over muddy terrain. The transporter remained for the Center's use. The effects of airflow on battle damaged composite material panels were experimentally investigated and found to be significant. Hydrodynamic ram forced delaminated material out of plane where fibers were caught in the airstream and peeled back toward the trailing edge. A series of low weight damage attenuation techniques were subjected to experimental evaluations and highly promising techniques were identified which would substantially reduce the damage due to airflow effects. The program planned for FY 1988 includes the continuation of many of the efforts described above and the initiation of advanced subsystem feasibility assessments and demonstrations in support of the Reliability, Maintainability, and Supportability (RM&S) and Hypervelocity Vehicle initiatives. Specifically, a frameless injection molded transparent canopy will be developed that is lighter and eliminates the many parts and seals of current windshield or canopy systems which contribute to low reliability, limited durability and high maintenance; the feasibility of robotics-assisted aircraft ground turnaround function, such as refueling, rearming and selected repairs will be demonstrated in bench model simulations; critical subsystems for an emergency crew escape module for hypervelocity vehicles will be defined; a subsystem tradeoff methodology for effective internal thermal energy management in hypervelocity vehicles will be developed and the feasibility of a unique heat exchanger will be experimentally assessed. The results of a composite materials vulnerability investigation to ballistic combat threats, together with validated damage attenuation schemes, will be transitioned to Product Divisions. During FY 1989, the laboratory evaluation of a closed loop vapor cycle environmental control system and the development of a catalytic converter for internal

vehicle chemical/biological agent contamination avoidance will be completed and both subsystems will be combined for effectiveness evaluations with simulated chemical/biological agents. The preliminary design of an integrated flight control/propulsion subsystem for a hypervelocity crew escape module will be initiated and analytical computer codes for vibration and transient thermal effects assessment will be combined with a knowledge-based executive program to provide an initial capability to predict the reliability and operational life of electronics due to environmental factors. The effectiveness of unique configuration and explosion suppression concepts for ballistically ignited fires in fuel tanks will be experimentally validated.

B. (U) Project: 2404, Aeromechanics. This project includes technology programs in the areas of aerodynamics, aerothermodynamics, performance analysis, configuration research, wind tunnel and flight experiments. During FY 1987, the project concentrated on the inlet/nozzle airframe integration for advanced airbreathing vehicles in the Mach 4 to 6 regime to support the initiative in hypervelocity technology. Innovative weapon carriage concepts were tested to define the most viable approaches for successful supersonic launch. An analysis program was developed to provide aero-acoustic prediction of weapon bay environment. The effects of maneuvering performance on the design, survivability, flexibility, affordability, and reusability of future hypervelocity vehicles will be completed. A joint effort with the Aero Propulsion Laboratory continued to examine the application of advanced configurations and air-breathing propulsion systems for the entire spectrum of supersonic airlaunched missiles which reduce flight time by 50 percent. This project also performed research in support of the hypersonic aerothermodynamics initiative by examining flight in the high altitude/low density regime and the effect on aerodynamics and aeroheating of hypersonic vehicles. During FY 1988, many of the programs mentioned above will continue with the addition of new efforts in: configuration concepts based on technology efforts of the past couple years for Vertical/Short Take Off and Landing (V/STOL) fighters; weapon configuration and weapon separation at hypersonic speed from hypersonic vehicles; advances in computational fluid dynamics codes for application to the design of hypersonic and V/STOL vehicles; experimental investigation of low aspect ratio vehicles at subsonic/transonic speeds and continued research on lift augmentation for V/STOL application and maneuver enhancement. The subsonic aerodynamic research laboratory will be fully operational and used to experimentally investigate high angle-of-attack aerodynamics and propulsion/airframe integration at high angles-of-attack to improve aircraft maneuverability and to provide experimental data for computation fluid dynamics code verification. Long endurance aircraft configurations will be examined for potential to achieve days and months of flight. Activity will be initiated to analyze hypersonic cruise configuration, including performance and the propulsion/aerodynamic interfaces. During FY 1989, efforts include low gas density aerodynamics and aeroheating and V/STOL configuration development. Configuration efforts will be initiated to examine the airframe/propulsion integration, controllability and terminal flight constraints. The investigation of flow separation on primary lifting surfaces will be initiated to determine methods of maintaining controllable flight. Lift augmentation research, using both leading edge and trailing edge devices, will continue. Experimentation to provide a sound data base for verification of compucational fluid dynamics methods will continue.

C. (U) Project: 3038, Technology Integration and Assessment. This project performs advanced vehicle concept synthesis, and technology integration and assessment to identify future military options available with new technologies. Advanced vehicle design concepts, technology applications, and an integration data base are the products accomplished through analysis of systems concepts, operational requirements, technology tradeoffs, and designs of

flight vehicles. During FY 1987, this project accomplished the following: Phase I completion of the Tactical Aerospace Assessment effort; Advanced Short Take-Off Vertical Landing (ASTOVL) configuration initial concept screening phase 40 percent complete; mission analysis and requirements study for ASTOVL 80 percent complete; in-house analysis to support proposal to DARPA covering the High Altitude Long Endurance (HALE) aircraft 70 percent complete. In the area of tactical warfare, a close air support/defense suppression study and an in-house advanced tactical transport study were completed; three analytical computer models which include Phase I of design methods for hypervelocity vehicles, interface code for radar cross section calculations, and airbase sortie generation analysis model were completed. During FY 1988 and 1989, this project is directed toward three areas: Global Tactical War Fighting, Control of Space, and Multi-mission Core Technology. The objective of the Global Tactical War Fighting assessment is to understand the role of technology relative to the global tactical perspective by obtaining a balanced assessment of the total worldwide tactical needs, understanding the key operational and system drivers, and exploiting opportunities for future development. The objective of the Control of Space assessment is to investigate the technological and operational issues associated with the integration of the reentry vehicles with the carrier vehicle. Multimission Core Technology includes five methodology areas: design, vehicle characteristics prediction, mission analysis, operational effectiveness and cost effectiveness. The objective of this element is to develop methods in these areas, to integrate these methods to develop the understanding to choose the best methods for the task, and to develop the knowledge to properly interpret the results generated. This project will continue to provide assessment of the application of technology for aeronautical system capabilities and the development of rationale for laboratory investment strategy using the goals of Tactical Air Warfare, Military Aerospace, and Technology Exploitation. These capabilities are included in the Supersonic Short Takeoff Vertical Landing (SSTOVL) technology options program, the Future Tactical Engagement Effectiveness investigation, the HALE Design Study, the Penetrating Tactical Transport for Special Operations concepts evaluation, and the Air Combat Environment Simulation for in-house air combat projects. During FY 1989, the focus of the technology assessment efforts will be tactical combat aircraft capabilities for high intensity conflicts. The options and opportunities identified in prior years will be quantified and ranked. The programs will emphasize integration of capabilities and technologies with existing assets and the response to new scenarios created by changing threat capabilities. The payoff will be a technology assessment that identifies critical technology capabilities, including military effectiveness, quantification of performance parameters, development of status, risk, and system integration requirements.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2401, Structures and Dynamics.

A. (U) Project Description: This project focuses on critical structural, dynamic and aeroelastic technology issues which affect the producibility, performance, safety, durability, and cost of aerospace vehicle structures. It sustains the Air Force's in-house technology base of structural analysis, design and test methods. It also develops design methods and test methods to develop survivable aircraft structures. It develops new structural concepts to increase strength and stiffness at minimum weight, complexity, and cost. This includes the exploitation of new material and fabrication processes.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In FY 1987 this project completed the structural evaluation of a new aluminum alloy which can operate at temperatures up to 600°F (a 30 percent improvement), allowing for the replacement of titanium in some applications and reducing the cost of fabrication to 25 percent for those parts. This technology transferred to advanced development under PE 63211F, Aerospace Structures and Materials. This project also: developed methods to predict the internal and external aeroacoustic environments for hypervelocity vehicles; developed full-scale high temperature test facilities for structural fatigue and fracture; and began the process of training industry to use the new specialized aircraft analysis and design computer programs for aeroelasticity and automated design.

(2) (U) FY 1988 Program: In FY 1988 an effort will be initiated to develop methods to take advantage of the synergistic effects of structures, flight control and aerodynamics (aeroservoelasticity) to drastically reduce airframe structural weight. Emphasis will increase in the development of dynamic test methods for aircraft and spacecraft structures in support of several systems. The project will remain the Air Force's center of in-house expertise for the static, thermal and dynamic testing of full-scale and reduced scale aircraft and spacecraft structures.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 this project will complete the evaluation of fabrication methods for new lightweight aluminum-lithium alloys to reduce fabrication costs to less than 75 percent of previous assembly methods. Integral damping to reduce structural noise and vibration in combat aircraft aft equipment bays will be completed and transitioned to advanced development. In order to validate analytic techniques, fabrication and testing of candidate structures representing vertical/short take-off and landing transports, fighters, and hypersonic aircraft will begin.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2403, Flight Control.

A. (U) Project Description: Flight control system design is critical to flight safety and battle survivability. This project provides the technology for survivability, stability and flight path control requirements and for obtaining maximum performance of advanced flight vehicles throughout relevant flight envelopes. This project develops control theory, performs aerospace vehicle simulation and analysis, designs cockpit concepts and pilot/vehicle interface design and integration criteria, develops stability and control methods, develops control sensors and actuators, conceives new control system architectures, integrates flight control with other systems, and develops control system design methods.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: During FY 1987 this project simulated an Advanced Flight Technology Integration (AFTI/F-16) fault detection and control reconfiguration. A reconfigurable flight control system is the

critical part that contributes both reliability and survivability. This simulation and the experiments performed thereon gave the Air Force its first total system look at the interaction of the new fault and damage detection logic with aircraft performance, the effect of the impairment of control surfaces on aircraft performance, the behavior of the aircraft in the critical transient when the control system is reconfiguring, and the impact on the flying qualities of the aircraft. The results achieved demonstrated that, for most impairments, the pilot could retain control of his aircraft and this capability could indeed lead to more aircraft being saved in combat. Also completed were the development of a holographic Heads-Up-Display (HUD) optic system, and the flight test of the Advanced Flight Technology Integration (AFTI/F-16) Automated Maneuvering Attack System (AMAS).

(2) (U) FY 1988 Program: During FY 1988 previous efforts will continue, and new programs will expand on efforts to address the complex nature of controlling highly manueverable fighters. To increase the capability of tactical fighters to land in adverse weather, a program will continue to investigate new landing control systems. To reduce the complexity associated with flying future aerospace vehicles, programs will be initiated to evaluate new cockpit designs. These efforts will include the simulation and crew mock-up of the designs. Among these is a program that will allow the integration of flight control and propulsion control necessary in Short Takeoff and Landing (STOL) vehicles. The technology will be transitioned to PE 63245F, Advanced Flight Technology Integration, for the STOL Technology Demonstrator program. A program will be initiated to develop fault tolerant flight critical software. This program will develop software capable of overcoming errors or damage to the control system computer.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, integration of the aircraft systems by consolidating electric and hydraulic power, fuel, and environmental systems will be continued resulting in fewer on-board computers. Efforts developing design criteria to expand fighter manuever capabilities will be completed. These studies include the effect of cockpit displays on the pilot's ability to perform the manuevers. The program to evaluate several control system designs for a boost glide vehicle will be completed.

C. (U) Major Milestones: Not applicable.

10. (U) PROJECT OVER $10 MILLION IN 1989:

(U) Project: 06FF, Laboratory Operations

A. (U) Project Description: This project provides for the management and support of the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. It includes pay and benefits for civilian engineers, scientists, and support personnel; travel, transportation, rents, communications, computer networks, and utilities costs; and procurement of supplies, equipment, and contractor support services. It also funds salaries, travel, and equipment of personnel at Aeronautical Systems Division that provide procurement support to the laboratory. This project supports and complements all the other projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602202F
DOD Mission Area: 552, Environmental and Life Sciences (ED)

Title: Human Systems Technology
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 47,460 | 48,946 | 49,801 | Continuing | N/A |
| 06MD | Human Systems Division Laboratory Operations | 23,753 | 24,218 | 25,243 | Continuing | N/A |
| 2729 | Chemical Defense | 3,165 | 3,816 | 3,700 | Continuing | N/A |
| 6302 | Occupational & Environmental Toxic Hazards in AF Operations | 3,983 | 3,946 | 2,746 | Continuing | N/A |
| 6770 | Biotechnology Studies in Advanced Systems | 98 | 630 | 800 | Continuing | N/A |
| 6893 | Manned Weapon Systems Effectiveness | 1,382 | 1,417 | 1,417 | Continuing | N/A |
| 7184 | Man-Machine Integration Technology | 5,889 | 5,855 | 6,440 | Continuing | N/A |
| 7231 | Safety & Aircrew Effectiveness in Mechanical Forces Environments | 3,100 | 3,057 | 3,189 | Continuing | N/A |
| 7755 | Aerospace Medicine | 800 | 806 | 806 | Continuing | N/A |
| 7757 | Radiation Hazards in Aerospace Operations | 3,508 | 3,346 | 3,546 | Continuing | N/A |
| 7930 | Advanced Crew Technology | 1,782 | 1,855 | 1,914 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program optimizes human aspects of the man-machine interface. The five key thrusts in this program area: (1) improve the performance of the human component of weapon system operations by refining crew selection, crew protection, and man-machine integration; (2) improve safety and protect Air Force personnel from radiation, chemical, and mechanical forces; (3) use our understanding of human factors to invent threats and countermeasures effective against Soviet weapon system operators; (4) develop chemical defense measures for air base operations, casualty care evacuation, and personal protective equipment; and (5) exploit and optimize man's utility in military space systems. This program also provides management and operational support for the three laboratories of the Human Systems Division.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 46,332 | 47,939 | 54,996 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 increase resulted from the combination of funds specifically directed for (1) the Installation Restoration Program and (2) a civilian pay raise. The increase in FY 1988 resulted from a combination of a reduction in the Federal Employees Retirement System and an increase for the Installation Restoration Program. The decrease in FY 1989 accommodates decreases in Air Force Total Obligation Authority. Projects to be affected by the decrease include research in: (1) Advanced Crew Technology, (2) Aerospace Medicine and (3) Manned Weapon Systems Effectiveness.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The program is formally coordinated with Army, Navy and NASA through a variety of mechanisms including the Tri-service Aeromedical Research Panel and the DoD Human Factors Engineering Technical Advisory Group. Where coordination is required on a daily basis, operating locations have been established with other organizations. These include Air Force positions with: HQ Army Medical R&D Command, Fort Detrick, MD; Naval Medical Research Institute, Bethesda, MD; and NASA, Langley, VA. Related program elements include: 0602720A Environmental Quality Technology; 0602777A Systems Health Hazard Prevention Technology; 0602205F Training/Simulation Technology; 0603227F Advanced Simulator Technology; 0603231F Crew Systems Technology; 0604703F Aeromedical Systems Development; 0602204F Aerospace Avionics; 0602702F Command, Control, Communications; and 0601102F Defense Research Sciences. Related flight dynamics program elements include 0602201F Aerospace Flight Dynamics; 0603205F Flight Vehicle Technology; and 0603245F Advanced Fighter Technology Integration. Related Army non-medical program elements include 0602622A Chemical and Smoke Technology; 0603806A Chemical/Biological Defense; 0603803A Chemical Systems Advanced Development; 0603759A Chemical Biological Advanced Technology; 0604803A Chemical Systems Engineering Development; 0604806A Chemical Biological Radiological Defense Equipment Engineering Development; 0605710A Joint Chemical Biological Point of Contact Test and Assessment; and 0601102A Defense Research Sciences. Related Army medical program elements include: 0602787A Medical Defense Against Chemical Warfare; 0603751A Medical Defense Against Chemical Warfare; 0604757A Medical Chemical Defense; 0603002A Medical Defense Life Support Materiel; 0604757A Medical Defense Life Support Materiel; 0603002A Medical Defense Life Support Materiel; and 0604757A Medical Defense Life Support Materiel. Related Navy program elements include: 0602233N Mission Support Technology; and 0604506N Chemical Warfare Countermeasures.

6. (U) WORK PERFORMED BY: The program is conducted by the Human Systems Division through its three laboratories: the United States Air Force School of Aerospace Medicine, Brooks AFB, TX; the Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; and the Air Force Human Resources Laboratory, Brooks AFB, TX. The in-house portion of the program is centered on unique, complex, man-rated experimental facilities at each of these laboratories. Such facilities are generally not available in the aerospace industry or academic institutions. The contract portion of the program complements the in-house efforts. The five major contractors are: Systems Research Laboratory, Dayton, OH (Project 7184); Northrop Services, Inc., Research Triangle Park, NC (Project 6302); Jaycor, San Diego, CA (Project 2729); University of Dayton, Dayton, OH (Project 7184); and Technology, Inc., San Antonio, TX (Project 7757). There are 46 additional contractors with FY 1987 contracts valued at $18.5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2729, Chemical Defense. This project provides the technology to ensure continued effectiveness of air operations and aeromedical care in the event of a chemical or biological attack. It is fully coordinated with the Army as the lead DoD agency for chemical and biological defense. Project goals are to enhance Air Force capabili ties in seven functional areas: individual protection; collective protection; detection, identification and warning; contamination control; medical operations; operations analysis for Air Force chemical and biological defense; and protective drugs and their performance effects. FY 1987 accomplishments included: (1) animal performance decrements were determined following repeated doses of nerve agent; (2) a chemical defense pretreatment drug was determined to have no effect on pilot performance during flight tests; and (3) the physiological demands such as workload and thermal burden were measured for medical shelter attendants in chemical protective suits. In FY 1988, milestones will include: (1) establishment of the physiological payoff of body cooling vests to reduce heat stress for labor-intensive tasks such a rapid runway repair; (2) determination of the interaction of pretreatment compounds on the threshold for effects from repeated low doses of nerve agent; and (3) development of the methodology for estimating casualties following chemical attacks to determine if planned medical resources are adequate. Research continues to work toward understanding the overall impact of chemical weapons on airbase operations, and minimizing those effect. In addition, efforts will be redirected to include analysis of the effects of new chemical agents, as well as biological agents. FY 1989 studies will include: (1) development of an infrared-based voice communication system for groundcrew to permit conversation on the flightline while wearing the chemical protective mask and hood; (2) initiation of a study on the threat from and impact of nuclear, biological and chemical attacks on airbases; and (3) assessment of the residual effects on performance following the recovery from exposure to high doses of nerve agent. Theses initiatives support a critical portion of the continuing technological base needed for the Air Force-specific requirements in chemical and biological defense.

B. (U) Project: 6302, Occupational and Environmental Toxic Hazards in Air Force Operations. This project maintains the only research and development responsibility within the Air Force for the toxicological assessment of Air Force materials and processes. Assessment of human tolerance levels for Air Force chemicals, fuels and materials is required to establish exposure criteria for engineering design of new systems as well as to perform trade-off analyses between weapon systems performance and occupational health and environmental support requirements. In FY 1987 accomplishments included: (1) production of Volumes II and III of the Installation Restoration Program Toxicology Guide which provides guidance for handling toxic compounds identified as part of the DoD Installation Restoration Program; and (2) specification of toxicity levels for a variety of aviation fuels including JP-7, JP-TS and JP-8. In FY 1988, studies include the toxicity of carbon slurries and shale derived JP-4, which are alternative high energy fuels currently under consideration for future Air Force use. In FY 1989 research will continue to emphasize the prediction of safe exposure levels to toxic compounds within the Air Force inventory, as well as to hazardous substances expected to enter the inventory in the near future. Work will be expanded on the Toxicokinetics Computer Simulation System which involves the development of a series of mathematical models specifically designed to permit predictions of human toxicity of hazardous compounds based upon non-invasive studies in animals. Measurements on the toxicity of new high energy fuels will also be expanded in coordination with the Aerospace Propulsion Laboratory to cover future concepts in energy sources. Therefore these toxicological assessments will directly support both current and future base operations involving potentially hazardous compounds.

C. (U) Project: 6770, Biotechnology Studies in Advanced Systems. This project funds national scientific and technical organizations, committees and tri-service groups for advice to the in-house scientists supported by this program element, thereby ensuring high quality, meaningful, coordinated, exploratory development efforts. This includes support to: (1) the Institute of Laboratory Animal Resources, to serve as a coordinating agency and a national and international resource for compiling and disseminating information on laboratory animals; (2) the National Academy of Sciences/National Research Council for workshops, symposia, and newsletters to provide a forum in which academic research scientists and Human Systems Division scientists can interact; and (3) the DoD Human Factors Engineering Technical Advisory Group for tri-service coordination and review of programs and semiannual reporting to the Office of the Under Secretary of Defense for Research and Engineering on tri-service research, development and applications of human factors. This project also supports the Human Systems Division's postdoctoral fellowship program. During FY 1987, accomplishments included: National Academy of Sciences reviews in the areas of noise-induced hearing loss, night vision and vision impairment, and support for three postdoctoral scholars for research on bioeffects of acceleration and high power microwaves. In FY 1988 and FY 1989 the National Academy will continue to evaluate relevant research programs for Human Systems Division laboratories. Moreover the Division will expand its postdoctoral scholars program to include two new positions in such areas as respiratory physiology, and the pharmacokinetics of toxic substances. FY 1989 working groups will include the areas of wrap-around visual displays, interactions of heat and vibration on hearing loss, and photoreceptor function in long term space flight. This project will continue to support other technical

advisory groups such as the DoD Human Factors Technical Advisory Group. This project for FY 1989 will provide (1) crucial expert review of Human Systems Division programs in such areas as bioacoustics, biomechanics and vision, and (2) the infusion of fresh ideas from academia through the postdoctoral program. Therefore this project directly helps maintain the credibility of the Human Systems Division as a Center of Excellence for human systems research.

D. (U) Project: 6893, Manned Weapon Systems Effectiveness. This project develops techniques to deceive the operators of enemy air-to-ground and ground-to-air systems. Visual camouflage, optical countermeasures and techniques to fool infrared and radar sensors are developed, simulated in the laboratory, and field tested. In addition, a variety of studies of human visual capacities are performed. Measurement of enemy anti-aircraft operator performance is accomplished with simulation and flight test. Blue Forces countermeasures are developed and transitioned to the Tactical Air Command, USAF Europe, and the Air Base Defense System Program Office. The need for motion in both engineering and training simulation is explored, including the modeling of visual/motion effects on operator performance. Specific FY 1987 accomplishments included: (1) a successful demonstration of flight testing of an airfield visual deception system, including such techniques as decoys to complicate both target acquisition and ordnance delivery by enemy aircraft; (2) quantification of the effects of attack aircraft tactics on enemy system and aircraft operator visual tracking performance; and (3) quantification of Blue Force crew performance in the optical acquisition and tracking of air-to-ground and air-to-air targets, for use when radar tracking is ineffective or undesirable. In FY 1988 and FY 1989 efforts will continue to specify (1) high payoff roles for military man in space, including the assessment of man's space-to-ground visual capability and (2) the technical basis and evaluation criteria for target masking and camouflage techniques based on human visual and cognitive processing. Specific FY 1988 mile stones include: (1) the continuation of field tests of visual deception techniques to improve airbase survivability; (2) studying the effects of microgravity on visual performance in cooperation with the German Aerospace Research Establishment as part of the continuing research into the effect of prolonged space missions on visual function; and (3) establishment of the feasibility of an optically based passive terrain-avoidance system for use when the radar emissions typically associated with terrain-avoidance devices may be counterproductive to mission accomplishment. FY 1989 studies will continue in these areas. New FY 1989 efforts include the development of a night side space visual performance system to allow visualization, from orbital altitude, of terrestrial objects during darkness. The daytime version of this concept has been prioritized by DoD in the top two experiments to be flown next in the Space Shuttle program. Another goal will be the simulation of a manned strategic threat system for predicting enemy responses during various combat scenarios. The FY 1989 program is a crucial link in the development of the Air Force program to deceive enemy aircraft and lessen their effectiveness against Air Force resources.

E. (U) Project: 7184, Man-Machine Integration Technology. This project develops procedures and technologies to improve the interface between human operators and electronic/mechanical systems. Information about the perceptual, cognitive, and response characteristics of human operators is measured within mission specific scenarios to provide

design data for system control and display development. Standardized methods are developed to measure and track the changes in weapon system performance as result of changes in man-machine coupling. Natural interfaces are those which least distract the weapon system operator from the important part of his mission. FY 1989 accomplishments included: (1) design of a B-52 crew station with night vision system compatibility; (2) design of the parameters for the new Command, Control and Communications workstation for the North American Air Defense Command; and (3) publication of the Handbook of Perception and Human Performance which provides guidance on all facets of the technology involved in man-machine interfaces. FY 1988 goals will include production of (1) a design of a B-1B defensive system display; (2) a prototype human engineering workstation incorporating practical Artificial Intelligence to optimize test and analysis formats for each study; and (3) and on-line analysis system for Crew Station Ergonomics for the more rapid assessment of workload. FY 1989 goals continue to support the development of new technology to improve man-machine integration. A virtual terminal for simulating air-to-air combat should be completed, as well as a brassboard display system with a wide field-of-view for the Super Cockpit initiative (program element 0603231F, Crew Systems Technology). The latter project will form a test system for many of the concepts currently envisioned for that portion of the Super Cockpit relating to visual interfacing. The FY 1989 direction for this project has the potential for significantly enhancing our current capability in the area of man-machine interface using many different technologies, and is a critical part of the Air Force endeavor to improve the performance of our current and future weapon systems.

F. (U) Project: 7231, Safety and Aircrew Effectiveness in Mechanical Forces Environments. Efforts within this project determine human response to a variety of mechanical forces: noise, impact and sustained acceleration, and vibration. This information is needed for the development of safe, effective escape/ejection systems, acceleration protection equipment, and restraint devices for aircrews. This project also develops data for operator-centered communications, communications jamming, and noise exposure criteria. FY 1987 accomplishments included: (1) completion of the advanced dynamics anthropomorphic manikin, which allows for lifelike dynamic testing of advanced escape systems; (2) demonstration of a computerized microphone system capable of actively reducing interference from the high levels of noise which occur in aircraft cockpits; and (3) tests of the ejection sequence and parachute inflation for the Advanced Concept Ejection Seat II under low speed low altitude conditions. Specific milestones for FY 1988 include: (1) the definition of the basic concepts for hypervelocity escape protection under the required aerodynamic conditions envisioned for the next generation of high performance aircraft; (2) definition of the concept of monitoring the loss of consciousness caused by a high-acceleration (G) environment, so that automatic corrective action can be taken until consciousness is regained; and (3) assembly of the apparatus to start research on robotic telepresence for sensing input and taking action within hostile environments. Efforts on the latter project are being coordinated with the Army, Navy and NASA. In FY 1989 resources will shift toward technologies to develop remote, closed-loop control of mobile robots by human operators. The objective is to link human judgement, adaptability, and dexterity in real-time to robots capable of operating in lethal environments. Work will also continue in the monitoring of loss of consciousness, and in the area of hypervelocity escape systems. The results from the FY 1989 studies can contribute directly

toward the expansion of the capabilities of today's weapon systems, as well as help define the conceptual boundaries of the new initiative in robotic telepresence.

G. (U) Project: 7755, Aerospace Medicine. The objectives of this project are to : (1) conduct research on medical conditions affecting aircrew selection and retention; (2) investigate methods of early disease detection, and determine the impact of these diseases on aircrew performance; and (3) conduct research in maintaining and possibly enhancing aircrew performance. In FY 1987, a study of contact lens applications in Military Airlift Command flight operations was completed, indicating that contact lens wear to improve visual acuity is acceptable for typical C-5 operational conditions. FY 1988 goals include: (1) development of medically approved new vision standards for aviators; (2) studying the potential use of contact lenses by Tactical Air Command, for not only improving vision but also enhancing aerial combat capability, since eye glasses do not remain in place during high-G maneuvers; and (3) studying changes in visual acuity of aircrew over their flying career to determine if the changes are similar to those of other populations, and whether selection criteria for vision should be revised. FY 1989 goals include: (1) integration and analysis of cardiological and other medical data presently residing in the Clinical Sciences data base to permit more confident judgement of the retention of aircrew members for flight duty; (2) the proposal of new medical standards for acceptance and continuation for USAF aircrews; and (3) demonstration of the feasibility of a technique using heartbeat synchronized inflation of the anti-G suit to counteract loss of consciousness during high-G maneuvers. These studies will build upon previous work in this project to (1) provide better guidance for selection and retention of aircrew, and (2) improve human performance in the weapon systems.

H. (U) Project: 7757, Radiation Hazards in Aerospace Operations. This project assesses biological effects, develops countermeasures and quantifies acute and delayed biological effects of: lasers; nuclear flash; and radiofrequency, ionizing and particulate radiation on Air Force personnel. It performs personnel hazard assessments, defines safe separation distances, develops protective devices, and develops the means to predict air and ground crews' ability to maximally perform in laser, radiofrequency or nuclear radiation environments. In FY 1987 accomplishments included: (1) reviewed technology advances in nuclear weapons; (2) completed the directed energy bioeffects laboratory designed for studies with high power radiation sources; and (3) completed field studies of potential hazards from high power microwaves. In FY 1988, results of a 20-year study of radiation exposure will be assessed to determine the frequency of cancer, cataracts and other illnesses related to ionizing radiation. In addition, extrapolation of biological effects of high power microwaves from animal models to man will be accomplished. In FY 1989, studies will expand in the effects of various forms of high powered radiation, and in the protection of aircrew from laser hazards. Efforts will expand on the bioeffects of high power microwaves. In addition studies will be done using the models of ionizing radiation on the battlefield to predict effects following the use of nuclear weapons. Finally, the effects of lasers on the eye will be studied in specific response to Tactical Air Command's Statement of Need for Aircrew Ocular Laser Protection. These efforts add together to provide the technology base required to continually assess the hazards

of ionizing and non-ionizing radiation weapons, and equip aircrew members with the necessary protection to perform their mission.

7. (U) Project: 7930, Advanced Crew Technology. This project develops design criteria and prototypes needed for improved protection of aircrews confronted by very high onset sustained acceleration (G) forces, spatial disorientation, thermal extremes, and hypoxia. Additional tasks involve the development and evaluation of aeromedical evacuation equipment and the evaluation and integration of life support equipment. In FY 1987 accomplishments included: (1) development of a physiologically based model of acceleration endurance; and (2) completion of studies on the advanced uniform pressure anti-gravity suit which will cover a larger surface area of the body to permit improved G tolerance. In FY 1988 emphasis will be on the development and evaluation of advanced high altitude protection systems. Specific milestones include: (1) development of a spatial disorientation trainer to help aircrew maintain their orientation during aerial maneuvers; (2) development of a predictive model for occurrence of bends to guide future experiments and help define techniques to reduce the likelihood of the bends; and (3) development of an electromechanical oxygen regulator to replace the cumbersome pneumatic regulator now in use. In FY 1989 studies will continue to pursue the protection of aircrew against the stressors that accompany operations in the aerospace environment. Goals include: (1) the use of high altitude protection technologies, in combination with an advanced development program for full pressure suits, to determine the appropriate onset time and rate of inflation for anti-G suits, in response to very rapid onset acceleration; (2) development of an anti-G breathing regulator to further enhance the beneficial effect of positive-pressure breathing for increasing G-force tolerance; and (3) initiation of a feasibility study for modernization and preventive maintenance of the School of Aerospace Medicine centrifuge. Pursuit of these goals will lead toward enhanced human performance under high G-force and other stressors associated with today's high performance aircraft, as well as the next generation weapon systems.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989:

(U) Project: 06MD, Human Systems Division Laboratory Operations

A. (U) Project Description: This project provides the resources to conduct in-house research and development activities of the Human Systems Division. These activities are predominantly conducted by specialized scientific teams using complex, unique research facilities and devices. The project provides for the pay and related costs of civilian physicians, scientists, engineers, and support personnel. It covers travel, transportation, rents, communications, utilities, laboratory supplies, unique equipment, and other related costs needed to conduct human systems technology research and exploratory developme . . also funds salary, travel and equipment for personnel at Aeronautical Systems Division to provide procurement su, e Human Systems Division.

Program Element: 0602202F
DOD Mission Area: 552, Environmental and Life Sciences (ED)

Title: Human Systems Technology
Budget Activity: 1 - Technology Base

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Eleven Data Exchange Agreements exist between Human Systems Division laboratories and various foreign countries on such matters as chemical defense and future equipment for pilots. Over 80 agreements exist with various DoD laboratories, government research facilities, universities and other research institutes.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602203F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Aerospace Propulsion
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 59,159 | 61,813 | 64,531 | Continuing | N/A |
| 06PP | Laboratory Operations | 20,218 | 21,411 | 21,844 | Continuing | N/A |
| 3012 | Ramjet Technology | 7,396 | 5,897 | 5,520 | Continuing | N/A |
| 3048 | Fuels, Lubrication and Fire Protection | 7,691 | 7,047 | 6,587 | Continuing | N/A |
| 3066 | Turbine Engine Technology | 15,459 | 20,618 | 24,200 | Continuing | N/A |
| 3145 | Aerospace Power Technology | 8,395 | 6,840 | 6,380 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program element develops air breathing propulsion and aerospace power technology in support of current and future aerospace vehicles and weapons systems. Major emphasis is placed on achieving high thrust to weight engines and technology for high Mach flight. Additional emphasis is placed on advanced power technologies for space applications calling for 10-30 kilowatt power levels. Laboratory exploratory development and component/subsystem evaluations are conducted in the technical areas of turbine engines, ramjet engines, fuels and lubrication technology as well as aerospace power generation, distribution and control technology. The program also provides for the management and support of the Aero Propulsion Laboratory operations at Wright-Patterson AFB, OH.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 59,723 | 71,233 | 69,733 | Continuing | N/A |

EXPLANATION: FY 1988 differences are due to Congressional Appropriation reduction. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority. The budget reductions reflected will delay implementation of the Integrated High Performance Turbine Engine Technology (IHPTET).

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Military Construction Funds | 2,750 | 0 | 0 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: This program receives information and basic technology from PE 0601102F, Defense Research Sciences. Materials technology used by this program comes from PE 0602102F, Materials. It provides component technology and design methodology to PE 0603202F, Aircraft Propulsion Subsystem Integration (APSI); PE 0603211F, Aerospace

Structures and Materials; PE 0603216F, Aerospace Propulsion and Power Technology, and others. Coordination with Army, Navy, Defense Advanced Research Projects Agency (DARPA), National Aeronautics and Space Administration (NASA), Department of Energy, Department of Transportation, Environmental Protection Agency, industry and academia is accomplished by joint projects, information exchanges and standing committees such as the Interagency Advanced Power Group, the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee, and NASA/Air Force semiannual meetings. In FY 1985 the Aero Propulsion Laboratory and Materials Laboratory began the High Performance Turbine Engine Technology (HPTET) initiative which is supported by Projects 3048 and 3066. The HPTET initiative is an effort to provide the Air Force with the technology base necessary for full-scale development of turbine engines with double the thrust-to-weight capabilities for all Air Force aircraft introduced after the year 2010. In the interim technologies will become available for all derivative and new engine developments. Beginning in FY 1988, HPTET becomes part of the Department of Defense (DOD)/NASA HPTET initiative which addresses the full spectrum of military aircraft turbopropulsion needs. The IHPTET initiative is also funded by 0602102F, 0603202F, 0603211F, 0603216F, 0602209A, 0603201A, 0602122N, 0602234N, and 0603210N.

6. (U) WORK PERFORMED BY: Work is managed and performed by the Aero Propulsion Laboratory, Wright-Patterson AFB, OH. Other Air Force organizations involved are the Aeronautical Systems Division, Wright-Patterson AFB, OH; the Space Division, Los Angeles AFS, CA; and the Armament Division, Eglin AFB, FL. The five major contractors for the program are: General Electric, Evendale, OH and Lynn, MA (all projects); United Technologies, East Hartford, CT, West Palm Beach, FL and San Jose, CA (Projects 3066, 3012, 3048); McDonnell-Douglas Aircraft, St Louis, MO (Projects 3066, 3012, 3145); Garrett Corp, Los Angeles, CA and Phoenix, AZ (Projects 3066, 3048); and Boeing Co., Seattle, WA (Projects 3012, 3048, 3145). There are 70 additional contractors working on contracts valued at $66 Million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3012, Ramjet Technology. This project develops airbreathing propulsion technology for future high speed aircraft, and missiles. Application of the technologies under development include: combined cycle engines including turboramjets and air turboramjets for aircraft and aerospace vehicles; scramjets (supersonic combustion ramjets) for hypersonic aircraft; liquid fueled ramjets, ducted ramjets, solid fuel ramjets and air turboramjets for high Mach applications. The expansion of advanced propulsion technology for high speed aircraft applications is a major change from previous years and results in a deemphasis on missile technology. FY 1987 Program: Major efforts on turboramjets, air turboramjets, and scramjets were initiated. The objective of this work is to dramatically expand the operational flight envelope for future aircraft. Analysis and initial improvement experiments have begun with the development of advanced structures for engines and will ultimately allow a 30 percent reduction in engine weight. This advance, plus integration of the engine in an aerodynamically configured vehicle design, will allow revolutionary improvements in performance. Continued progress in development of boron fuels for the solid fuel ramjet area was made. FY 1988 Program: Tests of scramjet engine critical components will provide a basis for future engine development efforts and vehicle designs. Turboramjet, air turboramjet, and liquid air cycle component efforts will be continued along with propulsion system design studies. Advanced structures work for high Mach engines will be completed and transitioned to advanced development or field applications. Revolutionary ducted ramjet technology will be initiated, possibly including joint programs with France and/or Germany. Boron fuel development for solid fuel ramjets will be completed and an engine design and demonstration program will be started. FY 1989 Program: Scramjet

engine component experiments will be completed and will provide the basis for a decision on continued development. Critical component development and tests for turboramjet, air turboramjet, and liquid air cycle engines will continue, accompanied by system design studies to guide the component activities. The turboramjet activity will emphasize tests specifically aimed at transitioning the technology to a future advanced development program. The ducted ramjet efforts will continue toward demonstrating greater flight envelope capability. The boron solid fuel ramjet engine demonstration program will be strongly supported.

B. (U) Project: 3048, Fuels, Lubrication and Fire Protection. This project provides: (1) improved Air Force fuels and the understanding of fuel/system capabilities required to support present and future airbreathing engine powered weapon systems; (2) lubricants, lubrication techniques, condition monitoring techniques, and lubrication system components (bearings, seals, dampers) to satisfy the stringent requirements of future aerospace weapon systems; and (3) advanced fire and explosion hazard characterization methodology, fire prevention and containment measures, hazard detection, and active and passive protection systems to satisfy flight vehicle safety requirements. This project supports the Aero Propulsion Laboratory/Materials Laboratory High Performance Turbine Engine Technology (HPTET) and Department of Defense/National Aeronautics and Space Administration (DOD/NASA) Integrated High Performance Turbine Engine Technology (IHPTET). Additionally, this project supports other Air Force commands in resolving operational system problems and coordinates the research, development, test, and evaluation of Air Force fuels, lubricants, and specialty fluid products for airbreathing propulsion and power systems. Missile fuel and fire protection technology efforts have been largely deferred. FY 1987 Program: Vaporizing/supercritical fuels (i.e. there is no phase change upon heating) and endothermic fuels (high heat sink capability) and fuel system studies were continued to determine the potential of using these fuels in high Mach systems. New programs were initiated to (1) correlate fuel properties with compositional molecular structures; (2) evaluate second generation endothermic fuel and catalyst candidates; (3) provide critically needed experimental data for the development and validation of fuel combustion models; and (4) measure the ignition delay characteristics of candidate endothermic fuels. A program was developed for solid-lubrication roller bearings for limited life engines. North Atlantic Treaty Organization (NATO) standardization and support activities continued. FY 1988 Program: A new start is planned to determine the fuel heat sink requirements for candidate high Mach flight vehicles. This data will be used to focus on-going programs in vaporizing/supercritical and endothermic fuels and fuel systems. An in-house program will be established to investigate the applicability of several mathematical models to fuel systems so as to integrate fluid flow, heat transfer, and fuel chemical kinetics into a single mathematical model. Fundamental combustion studies, in cooperation with industry, will be continued to provide experimental data for combustion model development and validation. Major emphasis of the lubricants and bearings programs will be directed toward HPTET requirements. A program to test candidate lubricants capable of operating between -60 and 400 degrees Farenheit will be initiated late in FY 1988. The development program on small, solid lubricated ball bearings for limited life engine systems will be completed. Solid lubricated roller bearing development will be continued. The analytical effort to identify lubrication needs for HPTET will be completed and will provide the basis for defining specific programs. A small-scale HPTET lubrication system simulator development effort will be initiated to evaluate small volumes of experimental lubricants and lubrication system materials. In addition, advanced bearings (including magnetic bearings) and seal development programs for HPTET application will be initiated. FY 1989 Program: Advanced fuels and fuel systems development will be continued with emphasis on vaporizing/supercritical and endothermic fuels, endothermic fuel catalysts, thermal stability, and fuel system components for high Mach systems. Basic fundamental

combustion studies, in cooperation with industry, will be continued. No new starts are planned. Development of several high temperature test devices for performance validation of advanced liquid and solid lubricants, bearings and lubrication system materials will be completed. Research and development on new bearings and seals--including definition of the potential for using magnetic bearings for high temperature engine systems--will be continued.

C. (U) Project: 3145, Aerospace Power Technology. This project supports development of solar power, fuel cells, batteries, hydraulics, power generation and conversion, power conditioning and transmission devices, and thermal management technology for both space and atmospheric flight vehicle applications. Current goals include increased power output, decreased weight and volume, decreased vulnerability, increased life and reliability, and increased environmental tolerance for future systems. Approximately 50 percent of the effort supports space power requirements. FY 1987 Program: Fault tolerant aircraft electrical system research and development was continued toward a demonstration in FY 1988. The application of Very High Speed Integrated Circuitry (VHSIC) technology in electrical generation systems to improve reliability and power density was begun. A program to demonstrate a multi-bandgap solar cell, with more than 50 percent improved power output, was initiated. Sodium sulfur space battery and high power density missile battery programs were continued as well as the low profile hydraulic actuator program for thin wing aircraft. Increased emphasis was placed on advanced auxiliary power unit (APU) components to include a dual mode combustor, and high temperture hydraulic seals. Thermionic energy conversion research (i.e. nuclear, solar or radioisotope conversion) was established. FY 1988 Program: The fault tolerant electrical system program and VHSIC technologies applied to aircraft electrical systems will be pursued toward advanced development. A high temperature dielectric polymer coating as insulation for advanced aircraft and spacecraft electrical systems will be initiated. A space power conditioning distribution and control technology effort will begin as the space foil bearing program will be completed. The multi-bandgap solar cell program will be extended because of promising results. FY 1989 Program: No new efforts are planned. The fault tolerant electrical power system demonstration and low profile actuator program will be completed. The multi-bandgap solar cell program will continue as will efforts in the area of high temperature hydraulic seals, advanced APU components, and high power density missile battery development.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3066, Turbine Engine Technology

A. (U) Project Description: This project develops technology to increase propulsion system operational reliability, mission flexibility, and performance while reducing fuel consumption, weight, and cost. Both analytical and experimental efforts are conducted in fans and compressors, high temperature combustors, turbines, secondary flow, controls diagnostics, exhaust systems, and structural design. This project considers the total propulsion system (inlet, engine, nozzle) and its integration into a weapon system. The principal focus of this project is in support of the High Performance Turbine Engine Technology (HPTET) program, a joint Aero Propulsion/Materials Laboratories technology development initiative. The primary goal of HPTET is to integrate efforts to provide, by the year 2000 the technology necessary to double turbine engine capability (e.g., 20:1 thrust-to-weight ratio fighter engine). These technologies will transition to the Aircraft Propulsion Subsystem Integration (PE 0603202F) and Advanced Turbine Engine Gas Generator (PE 0603216F, Project 681B) technology demonstration efforts for experimental validation and advanced

evelopment. (Beginning in FY 1988, this project, including High Performance Turbine Engine Technology (HPTET) became n integral part of a Department of Defense/National Aeronautics and Space Administration (DOD/NASA) technology development initiative).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Concentrated efforts continued on component development, advanced heat ransfer concepts, and structural/material innovations. More than 95 percent of this project was in support of the PTET program. Accomplishments of particular significance included the successful fabrication and spin test of a new iber-reinforced titanium compressor spacer ring. This spacer design permits more than a 90 percent reduction in ontemporary compressor disc spacer weight and provides the baseline technology for a fully integral blade and ring otor design with an overall weight reduction potential of at least 70 percent. Likewise, recent progress in advanced eramic composite material technology led to the successful demonstration of a small ceramic composite turbine rotor in n engine environment for potential high temperature propulsion application. Additionally, the first boron-aluminum omposite fan blade was successfully fabricated and engine tested at Arnold Engineering Development Center (AEDC) emonstrating lightweight, high strength, high-tip-speed damperless fan design technology for future propulsion system pplication. Emphasis continues to be placed on the in-house development and implementation of a new turbine heat ransfer and cooling research program to provide bench mark, high-quality experimental data in the areas of turbine ane and blade heat transfer, cooling air distribution and turbine airfoil aerodynamics. Preliminary test facility esign and necessary equipment layout were completed and in-house facility preparation is underway. In-house performnce characterization testing of an advanced, full-size, two-stage fan employing new swept-aerodynamic design technology as initiated in FY 1987 using the Laboratory's Compressor Research Facility. The swept-aero design will provide the asis for all future high-speed transonic compression system configurations applicable to both man-rated and expendable urbopropulsion systems. HPTET efforts initiated in FY 1987 were centered on a major, multi-award program resulting n twenty-seven (27) selected component development tasks involving six (6) engine companies and valued at $26 million. mphasis was placed on high risk component design innovation responding to the structural goals of HPTET while exploiing the latest in emerging fiber-reinforced, metal-matrix, and high-temperature ceramic composite materials. During Y 1987, the advanced concepts compressor system effort was successfully completed, paving the way for a revolutionary dvancement in compression system capability using the integral blade and ring design philosophy described above.

(2) (U) FY 1988 Program: During FY 1988, 100 percent of the Project 3066 budget allocation will be dedicated o demonstrating and maturing competitive Integrated High Performance Turbine Engine Technology (IHPTET) component techologies for subsequent transition to the Advanced Turbine Engine Gas Generator (ATEGG) program (PE 0603216F, Project 81B). Specifically, major emphasis will be placed on ongoing compressor, combustor, turbine, and innovative structural esign efforts leading to interim component and engine demonstrations in the early 1990's. The following technical ssues will continue to receive priority attention in support of IHPTET: (1) damage tolerant, very high-temperature omposites and fiber reinforced engine structures; (2) near-stoichiometric hot section designs; (3) damage tolerant itanium/aluminide metal matrix composites; (4) compact high-flow compression systems; (5) multi-function, lighteight controls/accessories; and (6) high-temperature metal alloys and refractory materials. Within the compressor rea, two significant technology demonstrations will be completed, both of which emphasize swept-aerodynamics and the

near-term goals of Integrated High Performance Turbine Engine Technology (IHPTET)--both demonstrations will provide the technology base for the next generation Advanced Turbine Engine Gas Generator (ATEGG) and Joint Technology Demonstrator Engine (JTDE) experimental engines. Efforts to be initiated in FY 1988 include three (3) technology base programs supporting the long-term goals of IHPTET while responding to the nearer term technology needs of an advanced Short Take-Off and Vertical Landing (STOVL) propulsion system: high-temperature shrouds, highly integrated STOVL exhaust systems, and advanced simulation technology for engine controls.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Again in FY 1989, the Project 3066 budget allocation will be dedicated to the continued demonstration and maturation of competitive IHPTET component technologies for subsequent transition to the ATEGG program (PE 0603216F, Project 681B). Specifically, major emphasis will continue to be placed on ongoing compressor, combustor, turbine, and innovative structural design efforts leading to interim component and engine demonstrations in the 1990's. The following technical issues will continue to receive attention in support of IHPTET: (1) damage tolerant very high-temperature composites and fiber reinforced engine structures; (2) near-stoichiometric hot section designs; (3) damage tolerant titanium/aluminide metal-matrix composites; (4) compact high-flow compression systems; (5) multi-function, lightweight controls/accessories; and (6) high temperature metal alloys and refractory materials. During FY 1989, a number of technical accomplishments/demonstrations within the IHPTET hot section area are expected: (1) validation of the IHPTET combustor dome/flow-path design; (2) characterization of a nonmetallic combustor liner for high-temperature operation, and (3) development of an advanced heat transfer design system for large man-rated turbine applications. Specific efforts will be the development of an advanced fan and low-pressure turbine design, high-temperature structural instrumentation, and hot section performance characterization using alternative fuels (to include cryogenic and endothermic fuels for high Mach propulsion system application). Efforts to be completed include the Advanced Turbine Rotor Design program, the Advanced Thermographic Phosphors program, the Compressor Stage Matching Investigation and Test program, and the Advanced Exhaust Nozzle Cooling Concepts program. Preparations for release of a new IHPTET Program Research and Development Announcement activity will be initiated in FY 1989; the overall goals and objectives will continue to be emphasized, with specifics focused on the priority issues cited above for technology availability in the mid-1990's.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06PP, Laboratory Operations

A. (U) Project Description: This project provides for the support activities required to operate the Aero Propulsion Laboratory at Wright-Patterson Air Force Base, OH. The Laboratory provides technical support to current and future systems programs and undertakes operational support projects in its mission areas. The project provides for the pay and related costs for civilian employees, travel, transportation, rents, communications and utilities costs, and procurement of supplies. It also funds salaries, travel, and equipment for personnel at Aeronautical Systems Division

providing support to the Laboratory.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602204F
DOD Mission Area: 521 - Electronics and Physical Sciences (ED)

Title: Aerospace Avionics
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 61,822 | 59,773 | 66,467 | Continuing | N/A |
| 06AA | Air Force Avionics Laboratory Operations | 30,937 | 32,073 | 33,516 | Continuing | N/A |
| 2000 | Active Electronic Countermeasures | 3,273 | 2,874 | 3,420 | Continuing | N/A |
| 2001 | Electro-Optical Technology | 2,123 | 1,930 | 2,296 | Continuing | N/A |
| 2002 | Microwave Technology | 5,566 | 4,852 | 5,771 | Continuing | N/A |
| 2003 | Avionics System Design Technology | 3,671 | 3,336 | 3,968 | Continuing | N/A |
| 2004 | Technology for Reconnaissance and Targeting Avionics | 1,884 | 1,719 | 2,044 | Continuing | N/A |
| 6095 | Inertial Reference and Guidance Technology | 1,649 | 1,419 | 1,773 | Continuing | N/A |
| 6096 | Microelectronics Technology | 3,458 | 3,136 | 3,731 | Continuing | N/A |
| 7622 | All-Weather/Reconnaissance Strike Avionics | 3,826 | 3,477 | 4,136 | Continuing | N/A |
| 7629 | Fire Control Avionics | 1,600 | 1,490 | 1,688 | Continuing | N/A |
| 7633 | Passive Electronic Countermeasures | 2,910 | 2,631 | 3,130 | Continuing | N/A |
| 7662 | Avionics Data Transmission and Reception | 925 | 836 | 994 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program is the primary source of new concepts, feasibility demonstrations, and technology evaluation for Air Force avionics system needs. It develops needed avionics technology for target detection and classification, fire control, navigation, communication, jamming and deception of hostile defenses. Avionics system design and avionics subsystem integration technology and the supporting technology of electronic devices and circuits are also developed. Avionics advances are needed to multiply weapon system effectiveness and yield enhanced reliability and reduced life cycle costs. The program also supports the management and support of the Avionics Laboratory, Wright-Patterson Air Force Base, OH.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 61,959 | 65,975 | 73,073 | Continuing | N/A |

EXPLANATION: (U) FY 1988 differences are due to Congressional action. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority.

Program Element: 0602204F
DOD Mission Area: 521 - Electronics and Physical Sciences (ED)

Title: Aerospace Avionics
Budget Activity: 1 - Technology Base

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is a broad technology base effort, and technology is exchanged between a large number of related program elements. The most significant are: Defense Research Sciences, 0601101E; Defense Research Sciences, 0601102F; Materials, 0602102F; Strategic Technology, 0602301E; and Command, Control, and Communications, 0602702F. Technology is further refined and demonstrated in related advanced development programs: Advanced Avionics for Aerospace Vehicles, 0603203F; Very High Speed Integrated Circuits, 0603452F; Advanced Integration Avionics, 0603253F; and Integrated Electronic Warfare System/Integrated Communication Navigation Identification Avionics Advanced Development, 0603109F. All electron device work is coordinated through the Advisory Group on Electron Devices which advises the Office of the Under Secretary of Defense for Research and Engineering. Developments in thermal imaging and image processing are coordinated through the Night Vision Technology Panel under the Joint Deputies for Laboratories Committee of the Joint Logistic Commanders. Many areas are coordinated through the Air Force/National Aeronautics and Space Administration Interdependency Working Groups on Space and Aeronautics. Radiation hardening activities are coordinated through the Radiation Hardened Electronics Technology Coordinating Group. Infrared sensor developments are coordinated through the Joint Technical Coordinating Group on Thermal Imaging Sensors. The Avionics Laboratory participates in a Joint Air Force/Navy Radar Working Group, a Tri-Service Airborne Displays Working Group, and a Tri-Service Background and Targeting agreement headed by the Air Force Armament Laboratory.

6. (U) WORK PERFORMED BY: The Avionics Laboratory, Wright-Patterson Air Force Base, OH, manages the work performed under this program. The five major contractors are: Texas Instruments, Dallas, TX (2000, 2002, 2004, 6096, 7622); Hughes Aircraft Company, El Segundo, CA (2000, 2001, 2002, 2004, 6096, 7622, 7629, 7633); Environmental Research Institute of Michigan, Ann Arbor, MI (2003, 2004, 7622); Georgia Institute of Technology, Atlanta, GA (2000, 2002, 2003, 7622, 7633); and Raytheon Corporation, Bedford, MA (2002, 7622). There are 71 additional contractors with contracts valued at $116 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 2000, Active Electronic Countermeasures. A large number of threat systems have been deployed, that use sophisticated methods of detection, tracking, and fire control these systems use an ever-increasing portion of the electromagnetic spectrum including the visible regions. This growth in threat capability requires the demonstration of countermeasures concepts and technology which will allow current, developmental, and new aircraft systems to accomplish mission objectives, and survive. This project addresses this need by demonstrating techniques using advanced technology to deceive or disable hostile electronic threats. FY 1987 Accomplishments:

A closed loop infrared countermeasures breadboard was fabricated and delivered for evaluation and technique refinement in the Dynamic Infrared Missile Evaluator facility. Advanced coherent digital radio frequency memory circuits were fabricated which demonstrated low noise levels which are important for accurate processing of received data. In parallel, acoustic charge transport technology was exploited to demonstrate an analog coherent memory circuit which promises significant

improvements in size, weight, and cost over current digital designs.

Phased array technology provides for improvements in reliability and reduction in size, weight, and power. Techniques to were demonstrated.

FY 1988 Program: Studies to identify optimum deployment strategies and parameters for such expendables will be accomplished. These efforts will further the development of active countermeasures to meet future threats. New approaches to the optimization of infrared flare performance in terms of spectral content, rise-time, and burn-time will be investigated.

Work will continue on advanced adaptive pointing technology to ensure accurate pointing of a laser beam over long distances and to improve techniques to correct for atmospheric turbulance using non-linear optical technology. FY 1989 Planned Program: A high power (one thousand watts) solid state array electronic countermeasures transmitter will be fabricated and tested. A breadboard demonstrating flexible modes of non-adaptive cross-polarization jamming will be fabricated and evaluated. In-house work will continue on the use of artificial intelligence in optimizing jamming resource management. The long wavelength laser for countering electro-optical trackers will be repackaged into a completely selfsupporting system capable of demonstrating critical component operation within the constraints of an aircraft system.

B. (U) Project: 2001, Electro-Optical Technology. This project develops low and medium power lasers, optical signal processing, and detector and focal plane array technology for target location, countermeasures, imaging, warning, tracking, and weapon delivery functions. The payoff will enhance performance with respect to increased range, variety of targets that can be detected, target resolution, and reliability for the avionics system functions cited above. FY 1987 Accomplishments: A carbon dioxide laser, using six coherently coupled waveguides was demonstrated with 110 watts output power. This laser has application for tactical laser radars for use in target identification and weapon delivery functions. Growth of frequency doubling material, potassium titanium phosphate, to produce one centimeter cubes with excellent optical quality has been demonstrated. This material has application in systems employing lasers and will result in improvement in laser efficiency. A fiber optic gyro using phase nulling techniques was demonstrated at a 0.1 degree per hour drift rate. Fiber optic gyros are easier to manufacture and are more rugged than ring laser gyros. FY 1988 Program: A tunable (2-5 micron) laser program will be started to develop and demonstrate an alternative to high average power chemical lasers for electrooptical countermeasures (EOCM). A broadly tunable visible laser program will be started to develop a source for tactical systems such as EOCM and search/track. A three-terminal opto-electronic development based on heterojunction structures will be started. Payoff is speed and optical switching for use in optical signal processing. The initial feasibility phase of gallium arsenide optical waveguide development, optical signal processing and interconnect functions will be completed. Optical analog/digital connector and organic optical waveguides will be started. These efforts will improve performance of signal processors. An effort to optimize gallium doped silicon infrared detectors will be initiated to increase quantum efficiency, thus improving performance. A gallium aluminum nitride ultraviolet detection demonstration via photoconductive, Schottky Barrier, and a photocathode

photodetector structure will be accomplished. FY 1989 Planned Program: A nonmechanically two-dimensional scanned laser program will be started using a rapidly tuned solid state laser. Optical rebroadcasting devices will be delivered and tested for use in potential optical processing input and memory applications to improve processing efficiency. New concepts in high speed scanning will be demonstrated for two-dimensional addressing for high speed input and access of optically generated data. Experimental optimization of long wavelength structured detectors will be completed.

C. (U) Project: 2002, Microwave Technology. This project develops the technology required to produce, control, and apply microwave and millimeter wave power. The scope of efforts includes theory, techniques, devices, circuits, and array/system concepts at frequencies below 300 Gigahertz (GHz). Areas of development are solid state sources and amplifiers, thermionic devices, power sensing and control, and phased array antenna techniques. System applications for this technology include rada , electronic countermeasures, and communications. This technology development will increase reliability and performance, and reduce size and cost of components vital to a variety of microwave and millimeter wave systems. FY 1987 Accomplishments. Improvements were in power generation and amplification from solid state devices. A silicon static induction transistor demonstrated 255 watts continuous wave (CW) power with 72 percent efficiency at 425 Megahertz. In the millimeter wave frequency region, both power and low noise gallium arsenide high electron mobility transistors were demonstrated at 60 and 94 GHz. These improvements were necessary to support radar, communications, and electronic warfare advanced systems. In the thermionic source area, fifteen hundred watts output power at 18 percent duty cycle was demonstrated in a 8-18 GHz traveling wave tube. At present traveling wave tubes provide the power source for radar, electronic warfare, and communications subsystems. Advances continue to be made in microwave and millimeter wave discrete devices and integrated circuits (IC). A broadband isolator demonstrated 1500 watts peak and 300 watts CW power handling capability over 8-18 GHz. Improved low loss millimeter wave ferrites for isolators and radio frequency switch applications were demonstrated. A monolithic millimeter wave IC amplifier was developed that achieved 50 milliwatts output power at 44 GHz. In the phased array antenna area, assembly and initial validation testing of an X-band solid state airborne radar array was accomplished. Over 2000 transmit/receive modules, each capable of 1.6 watts peak power, were fabricated, tested, and integrated into the array. Active phased arrays offer tremendous improvements in performance and reliability over present systems. Significant progress has been made in the development of broadband, multifunction, solid state array components. The developed components establish the technology base for arrays operating over the 4.5 - 18 GHz band in support of radar and electronic countermeasures shared aperture applications. FY 1988 Program: Solid state source and amplifier programs will continue to address microwave and millimeter wave transistor development. Work will be initiated to develop high efficiency transmit amplifiers for active aperture applications. Both narrowband (7-11 Gigahertz) and wideband (4.5-18 Gigahertz) high efficiency amplifiers will be developed. Work will continue to establish a data base and use the data to correlate gallium arsenide materials and device growth and performance parameters. The resulting information will be used to improve device performance and reproducibility. Programs started in FY 87 to develop microwave/digital and microwave/optical integrated circuits, to demonstrate increased levels of integration, will continue. High power tactical electronic countermeasures (ECM) source development work will be initiated. The object of this program is to develop an efficient source of microwave pulse energy suitable for tactical air/missile high power electronic countermeasures systems. FY 1989 Planned Program: Efforts to address improved high power microwave source technology and millimeter

wave power tube will be pursued. These efforts will have payoff in improved performance, system reliability, and greater application in radar. New solid state source and amplifier programs will address microwave and millimeter wave transistor development with emphasis on novel high yield device growth methods and wideband high power amplifier performance. Advanced wideband microwave and millimeter wave monolithic integrated circuit technology will be developed which will support the need to meet reduction in size and improved system performance and reliability. Complex digital-microwave-optical monolithic integrated circuit components will be demonstrated. Development of phased array feed networks using optical frequency beam forming and scanning will be initiated to reduce volume and simplify pattern control.

D. (U) Project: 2003, Avionics System Design Technology. This project develops advanced technology for design, integration and validation of avionics information and display systems with special attention on improved component reliability, reduced system development costs and pilot/vehicle interface issues. Project goal is to enable fully integrated crew stations and significant improvements in a pilot's knowledge, situation awareness, and the aircraft/weapon system management. FY 1987 Accomplishments: A proof of concept of an integrated avionics crew system using large area display, voice control and helmet mounted sight and display technology was demonstrated. A color matrix display was developed which is the first in the world to have the driver technology built around the edge of the panel. A liquid crystal diode projection system and a monochrome display with 254 lines per inch resolution were developed. These efforts have payoff in providing improvements to the display of information to pilots. A review was held on the first task of the Aircraft/Avionics Integration Study. The task review indicated that thermal management, opto-electronic interconnections and reliability and maintainability were critical areas for emerging high performance avionics. The preliminary design for the neural network threat response system including threat identification, incremental retraining of reflexive response, and learning of new responses was completed. This activity builds on the development of adaptive network based knowledge processing for applications in electronic warfare and radar signal processing. An Ada interactive workstation was delivered that provides increased software reusability. FY 1988 Program: Research will continue in cockpit display technology emphasizing graphic processing to improve presentation of situation awareness information to the pilot. Efforts will be initiated for knowledge engineering database and learning systems developments for pilot-aiding. Development of a signal processor with a tenfold increase in speed for airborne applications through the application of Gallium Arsenide (GaAs) will be initiated. Application and development of machine intelligence technology for pilot aiding, image processing, electronic warfare, software design and maintenance will continue. Research in biocybernetic workload evaluation for pilot aiding will be started. FY 1989 Planned Program: Research will continue on the cockpit display technology and expand to initiate the development of three-dimensional dynamic holographic cockpit displays. Research will continue for the development of a GaAs signal processor and expand to include Reduced Instruction Set Computer and parallel processing concepts. Application of machine intelligence continues. Investigations will be initiated into opto-electronics with payoff in increased processing speed.

E. (U) Project: 2004, Technology for Reconnaissance and Targeting Avionics. This project seeks to improve performance of reconnaissance, target acquisition, weapons delivery, and pilotage by advancing the capabilities of electro-optical and infrared sensors. Such improvements are required for successful use of low-altitude, high-speed tactical

aircraft and cruise missiles in a battlefield environment. These improvements will provide increased numbers of target kills per aircraft pass over the target area, decreased pilot workload, increased pilot/aircraft survivability, and a stealthy target/weapon delivery capability. FY 1987 Accomplishments: Fabrication was completed of a single thermal imaging infrared sensor that can perform the missions of several specialized sensors--namely pilotage, target acquisition, and weapons delivery. The investigation continued on a new technique for passive infrared imaging with potential for an increase in image detail for improved target assessment and discrimination. An investigation was started on the use of electronic stabilization to reduce the amount of image blurring caused by aircraft vibration and atmospheric turbulence around the aircraft. Additional hardware and software were procured to continue in-house measurements to characterize the laboratory performance and field test advanced thermal infrared imaging sensors. FY 1988 Planned Program: Development will begin on a sensor employing the new imaging techniques (based on progress in FY 1986 and 1987) to determine increased imaging capability. Payoff is improved target detection and identification. FY 1989 Planned Program: Efforts will be initiated to explore the realm of target, background and weather which could yield new techniques for target discrimination with electro-optical sensors and target recognizers. Efforts will continue on the use of electronic stabilization to reduce the amount of image blurring with payoff in improved target detection and identification.

F. (U) Project: 6095, Inertial Reference and Guidance Technology. The objectives are to improve the accuracy of inertial navigation systems/sensors for aerospace vehicles, cruise missiles and tactical strike weapons; develop integrated airborne antenna apertures for Communication, Navigation, Identification (CNI) systems; and to develop integrated reference systems concepts and architectures for improved mission capability. This includes precision low cost strapdown laser gyros, feasibility analysis and critical technology demonstrations of integrated CNI antenna apertures with low radar cross section and the exploitation of artificial intelligence techniques for integrated navigation system designs. These efforts are essential for improved weapon system mission effectiveness, supportability and low cost. FY 1987 Accomplishments: Requirements were established, concepts defined and configuration trade studies were initiated for an integrated communications navigation identification (CNI) antenna. An integrated CNI antenna will have payoff by reducing the number of different antennas on tactical and strategic aircraft. Architecture definition and system specification were completed for the application of artificial intelligence (AI) technology for management of multi-sensor navigation. The use of AI technology will provide for increased navigation performance and reduced pilot workload. FY 1988 Program: Efforts will continue to develop low cost laser gyro technology. An Adaptive Tactical Navigation System and computation techniques and software structure for a low cost and mission effective integrated navigation system will be developed and baseline demonstrations accomplished. An integrated communications identification navigation antenna aperture for Electronic Counter-Countermeasures will be continued. Payoff is reduction in system size, weight, power, and improved reliability and maintainability. FY 1989 Planned Program: Development will continue on advanced laser gyro concepts using multi-oscillators, and other technologies with emphasis on low cost, high reliability and improved performance. System software for the Adaptive Tactical Navigation system will be evaluated and specifications will be validated through a high fidelity demonstration model. A Kalman filter/software structure for strapdown inertial navigation systems which can perform special fault detection/isolation and reconfiguration functions will be validated and demonstrated. Hypervelocity technology base development for a broad range of hypervelocity reference system applications will be initiated.

G. (U) Project: 6096, Microelectronics Technology. This project develops selected solid state device and circuit technologies to achieve advances in information and signal processing capacity, reliability, and radiation hardness. Technical areas of consideration include integrated circuit devices and processing, high speed memory, signal processing circuit design, and interconnect technologies. This project is structured to complement developments in industry and other Government Laboratories. FY 1987 Accomplishments: Significant new silicon and gallium arsenide devices and processes were achieved that enhance speed, power, and integrated circuit performance with the transition of these to pilot lines and subsystem functions. Successfully investigated new approaches for the fabrication of advanced silicon devices. Transitioned a high speed (360 million samples per second) with 6 bit resolution analog-to-digital converter. A gallium arsenide high speed static random access memory was demonstrated. These devices have application in subsystems requiring high throughput processing. Computer Aided Design techniques were demonstrated that have reduced the nonrecurring cost of design by 30 percent. FY 1988 Program: Gallium arsenide integrated circuit technology will be continued and expanded. It will emphasize speed, lower power, and increased complexity with a trend toward developing the technological foundation for the monolithic integration of digital, microwave, and electro-optical functions. New device and interconnections concepts for future logic schemes and signal processing applications will be initiated. These devices will improve reliability by reducing the number of integrated circuits to accomplish a function. Gallium arsenide analog-to-digital converter technology and integrated logic and memory for digital radio frequency memory will be demonstrated and transitioned to advanced development. FY 1989 Planned Program: High performance devices technology emphasis will continue. These efforts will emphasize the development of bipolar and field effect device structures for application to future high speed signal processing subsystems. The feasibility of high speed and very low power complex complementary integrated circuits will be demonstrated, along with the demonstration of new inherent device interconnect schemes. All of these efforts support the need for improved performance and high reliability.

H. (U) Project: 7622, All-Weather Reconnaissance/Strike Avionics. This project develops the radar technology to support reconnaissance and strike operations using both airborne and spaceborne platforms. Radar is the only sensor that can acquire non-emitting targets at night, in all-weather conditions and, therefore, is widely used in both tactical and strategic applications. This project extends the inherent advantages of radar by establishing a firm technology base that supports: automated acquisition of small tactical targets; sensor concepts compatible with low cross-section airframes; radar operations in severe threat environments; and radar techniques effective against adversary low cross-section platforms. FY 1987 Accomplishments: Completed the synthetic aperture radar (SAR) targeting accuracy analysis program, where targeting approaches were formulated and performance evaluated. Results from this program have application for improvements to targeting/strike missions for the F-15 and F-16 aircraft. In-house capability was improved through the acquisition of radar models and simulations. Acquisition of this capability will aid in the development of methodologies for counter low observables and electronic counter-countermeasures. Transitioned high quality SAR data base to industry. This data base will provide information to industry for use in developing advanced automatic target cueing/classification software algorithms and hardware. FY 1988 Program: Design of promising approaches for an advanced Airborne Intercept Radar Counter Low Observable Program (AIRCLOP) to provide detection, acquisition and fire control capability against low radar cross section targets will be initiated. Hardware development for evaluation of multi-band polarization diversity techniques for enhanced surface target classification will be completed. Design of promising approaches for an advanced foliage penetration radar system will be initiated. A program to identify militarily useful experiments using Shuttle Imaging Radar assets will be initiated. Technology base synthetic aperture radar (SAR)

imaging efforts will continue. In-house activities including use of expert systems/artificial intelligence techniques for Electronic Counter Countermeasures (ECCM) and improved in-weather surface target classification will continue. FY 1989 Planned Program: Designs for the Airborne Intercept Radar Counter Low Observable Program will be completed. Measurements and evaluation of multi-band polarization diversity techniques will be initiated. Design of approaches for foliage penetration radar system will be completed. Technology base SAR Imaging efforts will continue. In-house activities for ECCM and target classification will continue. These efforts are aimed at improving Air Force Reconnaissance/Strcapability.

I. (U) Project: 7629, Fire Control Avionics. This project develops the methodology, software, and hardware implementation of fire control technology for increased accuracy in the delivery of weapons on targets. Specific goals are to develop requirements for the detection of targets and calculation of target locations; develop concepts which utilize advanced sensors, computers and data processing techniques to increase aircraft weapon delivery effectiveness and survivability; and demonstrate feasibility of these concepts by computer modeling and simulation. FY 1987 Accomplishments: Demonstrated the feasibility of using high resolution synthetic aperture radar for target recognition using synthetic imagery. Radar is the only sensor that is truly all-weather and is approaching the ability to produce imagery of the quality found in optical systems. Completed three studies in support of multi-mode fire control concepts. These studies concentrated on multi-sensor inputs for air-to-air combat and air-to-ground weapon delivery. Promising concepts were identified for future study. FY 1988 Program: A preliminary design will be initiated on internetted fire control which will perform integrated air-to-air and air-to-ground fire control and introduce the intra-flight internetting of shared data. A follow-on effort will be initiated in the area of program integration of advanced fire control sensors. An investigation of air-to-air attack algorithms for advanced fighter aircraft will be initiated. Efforts in real-time targeting, multi-spectral processing, and automated fire control will continue. All of these efforts are aimed at improving increased accuracy in the delivery of weapons on target. FY 1989 Planned Program: Preliminary design and investigations of internetted fire control for application to air-to-air attack algorithms for advanced aircraft will continue. An in-house program to develop techniques for evaluation of automated fire control systems will be initiated to support independent evaluation of contractor prepared software. System definition of an automated fire control will be initiated. These efforts will improve the capability of tactical aircraft to deliver weapons on multiple targets, increasing effectiveness and survivability.

J. Project: 7633, Passive Electronic Countermeasures. The objective of this project is to increase weapons system survivability

FY 1987 Accomplishments:

This powerful algorithm adds a new dimension to the threat identification matrix.

The experimental Infrared Array Receiver (IRAR) has been demonstrated in the field.

Laser Cross Section (LCS) measurements were made on seven samples of laser "chaff" materials.

A programmable signal preprocessor was delivered which is interfaced to the IRAR. This interface will allow development of data fusion algorithms to integrate infrared detections with radar detections. Other accomplishments include an acousto-optical tunable filter for fine spectral resolution laser detecting, and techniques to reduce the LCS of aircraft and radar cross-section (RCS) of airborne antennas. FY 1988 Program:

An effort to determine requirements for real time missile warning processing of IRAR output will be completed. Passively modulated expendables will be delivered

Upgrades to the in-house chaff simulation will be developed in parallel to simulate deployment of this type of expendable. FY 1989 Planned Program: Data from several aerodynamic expendables will be evaluated to determine the effectiveness of these glider type expendables against pulse doppler radars. Practical radar cross section (RCS) values at the proper doppler frequencies that can be achieved will be determined.

A handbook will be published documenting in one source all the laser cross section techniques and lessons learned from the past ten years. To support future LCS development programs, models of critical aircraft subsections will be fabricated on which to test LCS reduction treatments.

K. (U) Project: 7662, Avionics Data Transmission and Reception. This project addresses the growing need for a capability to transmit information to, from, and between aircraft with high integrity, low probability of hostile interception, and resistance to jamming and false transmission, along with small size and high reliability. Such links are vital for operations control, weapon guidance, and reconnaissance data transmission. This work is vital to provide battlefield commanders with needed intelligence in near-real-time and to provide aircraft the ability to communicate in the presence of sophisticated enemy jamming. FY 1987 Accomplishments: Completed demonstration of a software model program that will serve as a basis for sampling the environment and determine what signal format choice is appropriate for transmitting masking signals. This effort provides an approach for low probability of intercept communications. Completed the preliminary design for the Laser Communications Airborne Testbed (LCAT). The LCAT will be used to evaluate laser technology related to secure low probability of intercept, jam resistant air-to-air and air-to-satellite communications. Completed fabrication of an acoustic charge transport 32-tap and 128-tap delay line filter. This device will allow for improvements in signal analysis. FY 1988 Program: Continue all FY 1987 programs and initiate a new effort to mask communication signals within radar electromagnetic transmissions, a method that will improve the physical survivability of airborne platforms by allowing covert, uninterrupted communications in a dense, hostile environment. Methods will be addressed to allow for multiple, simultaneous message receive capability. The Laser Communications Airborne Testbed (LCAT) design will be completed. FY 1989 Planned Program: The LCAT terminal, which will be used to evaluate laser technology related to secure, low probability of intercept, jam resistant air-to-air and air-to-satellite communications, will be installed and flight tested. A new contract will be awarded to develop solid state laser beam steering technology capable of rapidly scanning over wide angles in a high "G" environment. Demonstration of adaptive signal masking concepts in a laboratory environment will be completed. In-house efforts

will be started to develop a threat simulator to interface with the Communications System Evaluation (CSEL) test facility. In-house research tasks using the CSEL facility will be started. These tasks include the effects of various blectronic countermeasures/electronic counter-countermeasures techniques on advance communications, navigation identification (CNI) systems, accumulation of a performance data base on discrete versus integrated CNI systems and methods of adaptive programmable communications.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06AA, Air Force Avionics Laboratory Operations

A. (U) Project Description: This project provides for the management and support of the Avionics Laboratory, Wright-Patterson Air Force Base, OH. It provides for the pay and related cost of civilian scientists, engineers, and support personnel; transportation of equipment; rental equipment; communications and utilities cost; procurement of supplies and equipment; duplication and reproduction services; and contractor support services for maintenance and modification of facilities. It also funds salary, travel and equipment cost for personnel at Aeronautical Systems Division who provide procurement support to the Avionics Laboratory. This project supports and complements all other projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602205F — Title: Personnel, Training, and Simulation
DOD Mission Area: 522 - Environmental and Life Sciences (ED) — Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 23,518 | 31,916 | 31,026 | Continuing | N/A |
| 06HT | Laboratory Support | 6,723 | 10,225 | 10,207 | Continuing | N/A |
| 1121 | Technical Training Development | 2,173 | 2,031 | 1,950 | Continuing | N/A |
| 1123 | Flying Training Development | 2,919 | 2,824 | 2,793 | Continuing | N/A |
| 1192 | Advanced Simulation for Pilot Training | 5,125 | 5,525 | 5,456 | Continuing | N/A |
| 1710 | Logistics and Maintenance Technology | 3,690 | 3,996 | 3,640 | Continuing | N/A |
| 3017 | Command and Control Training | 1,190 | 1,485 | 1,395 | Continuing | N/A |
| 6114 | Flight Simulator Technology | 1,698 | 1,247 | 1,215 | Continuing | N/A |
| 7719 | Force Acquisition & Distribution System | * | 3,524 | 3,370 | Continuing | N/A |
| 7734 | Force Management System | * | 1,059 | 1,000 | Continuing | N/A |

* In FY 1987 Projects 7719 and 7734 were funded in Program Element 0602703F. In FY 1988, all projects formerly funded in Program Element 0602703F were consolidated into Program Element 0602205F to meet Congressional direction to reduce the number of Program Elements.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program will improve operational readiness and effectiveness by developing technologies to enable more effective training, selection, assignment, and retention of personnel. This program also provides the technology to increase weapon system supportability. Major research efforts are on aircrew training using various flight simulation devices to develop innovative methods for flight simulator training, define simulator training effectiveness requirements, and develop innovative techniques for training tactics for air-to-ground and air-to-air combat. Other research involves improved individual and unit training methods, instructional and learning strategies, and training design and evaluation technologies. Specific technical programs include development and demonstration of: personnel testing procedures, methods to determine Air Force job requirements, processes for matching individuals to jobs, models and strategies to improve retention, the means to measure and evaluate job performance in order to link enlistment standards to on-the-job performance, models for integrating manpower personnel and training decisions, computer modeling to address fundamental training management issues, tools for computer-based training, maintenance training simulators, and artificial intelligence applications to training. Another major R&D area addresses the logistics support of weapon systems and improvements that can be made by specifying the interactions between the human elements of the logistics and maintenance systems, and the associated characteristics of weapon systems. This program also provides management and operational support for the AF Human Resources Laboratory, Brooks AFB, TX.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 36,608 | 35,937 | 36,810 | Continuing | N/A |

EXPLANATION: (U) In FY 1987 Projects 7719 and 7734 were documented in Program Element 0602703F. The FY 1988/1989 Descriptive Summary listed funding for those projects for comparability purposes. The FY 1988 reduction is the result of Congressional Budget action. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority. These cuts will result in the cancellation of development of advanced thermal imagery models for sensor simulation supporting aircrew training effectiveness R&D. Efforts to develop generic aero models and advanced radar imagery for flight simulation will also be cancelled. Development work to validate the use of Job Performance Measures developed in Program Element 0603227F, Project 2922, for use in classification and training will be eliminated. Studies to equate the Armed Services Vocational Aptitude Battery for high school students will be delayed by at least one year.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Related program elements are: 0601102F, Defense Research Sciences; 0602202F, Human Systems Technology; 0602204F, Aerospace Avionics; 0602702F, Command, Control, and Communication; 0602763N, Personnel and Training Technology; 0603707N, Manpower Control System Development; 0602717A, Human Performance Effectiveness and Simulation; 0603106F, Logistics Systems Technology; 0603227F, Manpower, Personnel, Training, and Simulation Technology; 0603231F, Crew Systems Technology; 0604227F, Flight Simulator Development; 0602757N, Human Factors and Simulation Technology; 0603733N, Training Devices Technology; 0603720N, Education and Training; 0602722A, Manpower, Personnel, and Training; 0602727A, Non-System Training Devices Technology; and 0603216A, Synthetic Flight Simulators. The Air Force Human Resources Laboratory has formal agreements with: the Army Program Manager for Training Devices, for visual display and advanced computer image generation technology development; Tactical Air Command for flying training R&D and to help develop flight training schedules using Advanced Instructional System software; Aeronautical Systems Division, to coordinate simulator research and development with the Deputy for Simulators; Air Force Wright Aeronautical Laboratories, for development of computer-aided design technology; the Army Research Institute (ARI), the Navy Personnel Research & Development Center, and the Naval Training Systems Center, to share development of a computerized instruction system. There are also formal agreements with the Air Force Armstrong Aerospace Medical Research Laboratory and Rome Air Development Center, to share research products related to command and control systems. The Navy has a liaison office with the Human Resources Laboratory's Operations Training Division at Williams AFB, AZ. Air Force efforts to improve the Armed Services Vocational Aptitude Battery and the production of new forms of that test are directed, in part, by a Tri-Service steering committee of General Officers. In addition, DOD Technical Advisory Groups provide coordination between specific focal points for research and development efforts. Close coordination within the Air Force user community is also ensured by annual research and development coordination meetings between the Air Force Human Resources Laboratory, the Aeronautical Systems Division, and the Major Commands. Efforts across all Services to develop job

performance measures are coordinated by a working group monitored by the Office of the Assistant Secretary of Defense for Force Management and Personnel.

6. (U) WORK PERFORMED BY: This program is managed by the Air Force Human Resources Laboratory (AFHRL), Brooks AFB, TX. Four Laboratory divisions support this program element: Manpower and Personnel Division, Brooks AFB, TX; Logistics and Human Factors Division, Wright-Patterson AFB, OH; Operations Training Division, Williams AFB, AZ; and Training Systems Division, Brooks AFB, TX. An Operating Location of the Training Systems Division is collocated with the Air Training Command Technical Training Center at Lowry AFB, CO. The major contractors are: University of Dayton, Dayton, OH (1123, 1192, 6114); General Electric, Daytona Beach, FL (1192, 6114); Singer Company, Binghamton, NY (1123, 1192, 6114); McDonnell Douglas, St Louis, MO (1123, 7734) and Aurora; CO (1121), and Universal Energy Systems, Dayton, OH (1121, 3017, 7719). There are 74 additional contractors with contracts totalling $9.6 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 1121, Technical Training Development. Efforts to improve training delivery, development and effectiveness must be maintained to stay abreast of Air Force training requirements and ensure that training produced is cost-effective and mission-relevant. This project develops training technology to enhance individual and unit training. The result will be improved individual skills development and job performance. Efforts include: using computers to investigate and measure job performance; developing computer-based training (CBT) delivery, management, and evaluation systems; and investigating and demonstrating artificial intelligence (AI) applications for training. During FY 1987, Instructional Support System (ISS) technology was used as an embedded training capability in the Advanced On-the-Job Training System (Project 2557, PE 0603227F). Additionally, during FY 1987, ISS was rehosted to a minicomputer; videodisc and compact Computer Managed Instruction (CMI) capabilities were added; and on-line and off-line user training materials were completed. A joint effort with the Army Research Institute and the Naval Training Systems Center in FY 1987, completed development of a student knowledge model for use in development of intelligent training systems. Development of an intelligent tutoring system based on a previously developed intelligent maintenance aid continued. In FY 1988, the Tri-Service contract for intelligent systems is building intelligent authoring aids for training development, and designing and developing knowledge-bases for multiple AI applications. ISS instructional authoring and delivery software are being rehosted and field tested for the Zenith 248 microcomputer. CMI rehosting to the Zenith 248 computer and field testing will follow in FY 1989. Research will be conducted on the relationship between training and job aiding and design of instructional sequencing and delivery strategies. This work will continue during FY 1990 along with investigations to establish baseline criteria for CBT selection for Air Force training. Also in FY 1988, efforts will continue on intelligent tutorial systems, and efforts to use advanced interfaces to enhance the human-computer interaction. Efforts to determine the feasibility and effectiveness of using intelligent tutorial systems to increase learning and job competency will also begin. In FY 1989, the Tri-Service effort will complete development of software tools for use by courseware authors in developing intelligent training systems, with specific demonstrations to take place in space operations training at the Undergraduate Space Training School. These tools will be designed for use by subject matter experts without the need for extensive training or background in instructional design or computer programming. In FY 1989, an intelligent instructional design will be developed for the space operations environment.

B. (U) Project: 1123, Flying Training Development. The Air Force must provide extensive training to ensure the combat readiness and survivability of its aircrews. In order to accomplish this training in an efficient and effective manner, this project applies new concepts and methodology, demonstrates and evaluates new devices and performs exploratory development to solve training-related problems. In FY 1988-1994 Project 1123 contains six major thrusts directed towards achieving the goal of improved Air Force training. The Total Training System Design effort addresses the entire spectrum of aircrew training required by a major weapon system to determine the best ways of managing and delivering instruction as well as assessing the value of the training program. In FY 1987-1988 the initial products of this effort will include specifications for system design and guidelines for computer-aided training management. The Performance Measurement effort is fundamental to all research and development activities and this program will generate validated scoring algorithms for A-10, F-15, and F-16 air-to-air and air-to-surface combat. These algorithms will be usable in both the Weapons System Trainer (WST) and the aircrafts' Air Combat Instrumented Range. In FY 1988 development will continue on an artificial intelligence model of pilot knowledge structures to be used in improving air combat decision-making strategies. The Multiship Instructional Support System effort, starting in FY 1988, will use modular software to allow centralized control of simulator training in the many versus many tactical a na. One aspect of this work in FY 1988-1989 will concentrate on optimizing the computer/operator interface to effectively manage this complex environment and minimize necessary operator training. Using the advanced image generation and display hardware developed in PE 0603227F, Personnel, Training, and Simulation, the Visual/Sensor effort in FY 1987-1989 will explore the training effectiveness of display features for simulation. Studies to be completed in FY 1988 define the criteria for simulator display resolution and the level of detail for air-to-air and air-to-ground simulated tactical targets. Research in FY 1988-1989 will investigate brightness/contrast/resolution tradeoffs, scene content and color requirements, thermal modeling for infrared, terrain accuracy specifications for real beam radar, and data base density requirements, for synthetic aperture radar. The Electronic Combat Training effort in FY 1989 will begin to develop a modular threat simulation system for broad-based application to all Air Force training devices as well as produce a systematic investment strategy for electronic combat training. The investment strategy will establish a framework for training media selection and skill/task requirements for electronic combat. The Special Function Trainer effort will use prototype part-task trainers on-site at MAJCOM operating locations to demonstrate the ability of such devices to offload WSTs and aircraft with low-cost, but high-value practice. This effort will result in establishing device design guidelines for MAJCOM training programs and offers the potential to reduce instructor workload through computer assisted and managed instruction.

C. (U) Project: 1192, Advanced Simulation for Pilot Training. This project provides for the operation, maintenance, and modification of simulation equipment and software that is the foundation for research on training effectiveness and flight simulator engineering R&D. This capability includes dome, dodecahedron, and helmet-mounted visual displays; computer image generation systems; and related research equipment. These simulations systems support research conducted under Project 1123, Flying Training Development, and Project 6114, Flight Simulator Technology, as well as research conducted under PE 0603227F, Personnel, Training, and Simulation, and thus provide the capability for implementing, demonstrating, and testing training technology and simulation hardware advancements. This capability is also used for demonstrating and testing engineering and training simulation technology advances developed under related Aeronautical Systems Division and Tri-Service program elements listed under related activities. Installation/ integration of a new basic-side (nonvisual) control computer with much higher processing rates, capable of matching the

characteristics of current state-of-the-art tactical aircraft continued in FY 1987. This will permit dual cockpit simulation with full sensor capability, coupled with the out-the-window visual imagery. In FY 1987, development of a functionally distributed parallel microprocessing capability began. Enhancements to the existing F-16A instructor/operator station to allow improved instructor/operator and student/pilot interaction were completed. Hardware integration and software development for the new basic-side (nonvisual) control computer will be completed in FY 1988. Support will continue in FY 1988 and FY 1989 for the operation and maintenance of all major simulator systems, including the Advanced Visual Technology System image generator (Project 2363, PE 0603227F). Simulation support for related research projects will also continue, including training effectiveness and transfer of training studies, visual and sensor systems requirements studies, and tactical combat mission simulation studies.

D. (U) Project: 1710, Logistics and Maintenance Technology. Acquisition of weapon systems that are logistically supportable, sustainable, and cost effective is being emphasized by all levels of the Air Force and DOD. Military systems must be durable, easily maintained/repaired in the field, and require little or no support equipment. The objective of this project is to develop technologies for improving the logistics support of Air Force combat operations. In FY 1987, work was done on the identification of tradeoffs in personnel, job aids, and support equipment to minimize the manpower and equipment necessary to conduct aircraft maintenance in dispersed locations. In FY 1987, a computer graphics model of maintenance technician physical characteristics (reach, grip, hand motions, etc.), for use in designing human factors into equipment, was refined and interfaced with a commercial computer-aided design package for transition to Government and industry users. The analysis and testing to determine the ability of personnel to complete maintenance tasks while wearing chemical/biological warfare protective clothing will be completed in FY 1988. Also in FY 1988, a new effort will begin to develop a computer "super" model to assess theater-wide combat logistics system resources and requirements, using an operations model as a core. Planning, logistics assessment, and susceptibility models will be used as modules to provide more realistic computation of wartime logistics capabilities. An FY 1988 new start will evaluate the use of advanced graphic techniques to integrate reliability and maintainability information into computer-aided design. In FY 1989, work will commence on an advanced modeling program that will eventually result in a highly effective method to model unit capability through discret-event simulations. In addition, work will continue on the development of decision aids for application in the acquisition logistics process. Also in FY 1989, a model for forecasting wartime logistics requirements will be completed and historical combat data will be collected to validate the model.

E. (U) Project: 3017, Command and Control Training. Combat readiness of personnel assigned to man tactical Command and Control ($C^2$) systems is directly related to their ability to operate smoothly and efficiently in a rapidly changing tactical environment. The failure of $C^2$ systems is often due to inadequate attention being placed on personnel training requirements and other human factors considerations during the design and development phases of new systems. There is a recognized need for improvements in $C^2$ training for Tactical Air Force battle staff personnel. This project develops technology and applications programs to analyze wartime job requirements and performance standards, determines training requirements, identifies and models the impacts of automation on operators, analyzes combat decision making, and develops new technology for training devices. FY 1987 efforts included: development of a prototype special simulation device for training combat mission planners, development and testing of an automated method for ongoing dynamic update of a worldwide command and control training requirements baseline, and exploration of

computer-aided concepts to provide more precise threat avoidance information for mission planning. Also, work began on methods to simulate the impact of automating previously manual command and control functions. A preliminary training technology requirements study was accomplished and expert performance task analysis data collected at the 712th Air Support Operations Center (ASOC), for Air Force Space Command. Human factors consultation and support for the Strategic Defense Initiative (SDI) was provided to the ASOC, the Electronic Systems Division, and the Naval Research Laboratory. In FY 1988, knowledge based training system concepts will be developed for combat operations functions, expert system based task analytic collection devices will be tested, prototype microcomputer-based training devices for command and control wil be developed, and initial design work for embedding training programs in decision aids being developed at the Rome Air Development Center (RADC) will begin. In FY 1989, work will begin on the information/decision analysis for a functionally distributed tactical command and control architecture in development at RADC. Also, exploratory work will begin on a microcomputer-based desktop trainer for ground-based operators of space-based systems. In FY 1989, the prototype knowledge-based training system for tactical combat operations will be tested and validation/verification of $C^2$ system designers' work station to assess automation impacts will be completed. Further, the architectural concepts of functionally distributed command and control will be tested at multiple locations. Simulation methods for evaluating the impact of automation on manual command and control processes will be demonstrated in FY 1989-1990.

F. (U) Project: 6114, Flight Simulator Technology. The Air Force must improve the quality and cost effectiveness of aircrew training. This project develops efficient and effective simulation hardware technology for future aircrew training systems. These technologies will provide sufficient mission realism for aircrew training and weapon system exercise and assessment. In 1987, efforts continued on exploring the feasibility of using low-cost image generation architecture for producing a simulated real beam radar scene from Defense Mapping Agency compressed data bases. In FY 1988, work on a small-dome visual display system will continue to apply variable-acuity display technology to air-to-air and to air-to-ground tactical training. In FY 1989, this work will continue in order to meet a tactical Air Command need for simulation in this area. Small-dome visual display R&D will also provide training effectiveness data for other training simulation applications. For this work, major emphasis will be given to visual systems comprised of electro-optical displays and microprocessor-based computer image generators.

G. (U) Project: 7719, Force Acquisition and Distribution System. This project provides the Air Force with methods to ensure the best qualified individuals are recruited, selected, classified, and assigned. This is accomplished through research and development of personnel qualification and aptitude tests, job specification standards and manpower and personnel models. Experimental test batteries will be developed in areas such as attention sharing, eye-hand coordination, information overload, self-confidence and others. As the DoD Executive Agent for the Armed Services Vocational Aptitude Battery (ASVAB), the Air Force must provide the technology base for revising and updating the content and structure of this test which is used by all Services for selection and classification. Research to improve selection of pilot trainees and the subsequent assignment of pilots to specialized training continued in FY 1987. Preliminary data indicate this research will lead to reduced pilot training attrition to achieve significant savings. In FY 1987, a major new effort continued to consolidate ongoing job requirements and modeling research and initiate new projects to develop a manpower personnel and training integration system (MPTIS). The MPTIS will provide tools, such as models and data bases to support system design, developing personnel and training pipeline and retraining requirements for fielding new weapon systems, and integrating the MPTIS decision process into existing systems. Also,

in FY 1987, exploratory development continued on the Air Force Officer Qualifying Test (AFOQT) and the Armed Services Vocational Aptitude Battery (ASVAB). Three new editions of the ASVAB will be implemented during FY 1988 and work will continue to improve selection and classification methods through basic skills assessment research, manpower personnel and training integration system related efforts, and testing research and validation. Also in FY 1988, task demands in air combat will be determined, characteristics of successful fighter pilots will be identified, and specialized tests for classification of pilot candidates for specialized pilot training will be developed. In FY 1988, a study will be completed to develop a methodology for determining the value or cost of replacement of trained and experienced personnel. This study is in direct response to the FY 1984 Authorization Bill language which directs the DoD to fund the development of models and procedures to enhance retention of personnel. The primary benefit of this costing methodology will be the establishment of the relative value of Air Force personnel with different levels and types of skills, enabling Air Force managers and planners to respond in a more informed manner to dwindling manpower pools, decreased retention, budgetary constraints, and policy decisions. In FY 1989, projects will continue to provide new, alternate, or replacement forms of tests to be used in the Air Force as well as other Services and DoD sponsored high school student testing programs. Efforts will continue to develop valid measures of fighter aircrew performance and in-depth analyses of task/information processing demands. Research into the determination of valid entry level standards for specialties will provide information and technology in the basic skills requirements of Air Force jobs and functional skills. Also in FY 1989, a final evaluation of the EURO-NATO Joint Jet Pilot Training Program will be completed.

H. (U) Project: 7734, Force Management System. The Air Force needs to develop methodologies for assessing individual performance on the job and predict effective job performance. Improved measurement techniques will enhance individual performance and unit effectiveness at all organizational levels. These techniques will also be used to develop a training decision system (TDS) for answering questions such as when and where personnel should be trained, and on what tasks. The TDS includes a more comprehensive and better unified data base and better decision modeling technologies than ever available for estimating the training cost, resources, and capacities associated with optional patterns of training and personnel utilization. The development of task-level job performance measurement techniques will continue, as will the development of on-the-job performance measures against which selection devices, such as the Armed Services Vocational Aptitude Battery, are to be validated. The Congressional direction to link enlistment standards to on-the-job performance measures has resulted in close monitoring of this effort by the Office of the Assistant Secretary of Defense for Force Management and Personnel. In FY 1987, job performance measurement efforts continued to study global/general supervisory ratings and task-level ratings as effective job performance measures. In FY 1987, TDS integrated data from task analysis, training cost studies, and policy development models. In FY 1988, TDS will simulate and project consequences of user specified utilization and training options and develop optional trading designs. In FY 1989, TDS will apply software to four AF specialties (AFS) for system refinement and validation. Work will begin, to explore the automation of data collection and the application of training decision-making technology to such problems as AFS consolidation and training requirements for new weapon systems. Also in FY 1989, the performance measurement technology will initiate work in training evaluation, in order to develop training requirements definition, and training content and method selection upon job performance based data. Studies will explore and identify links between existing AF management information systems and objective measures of job performance. Work will continue in support of the development of a transitionable job performance measurement system through FY 1992.

Program Element: 0602205F | Title: Personnel, Training, and Simulation
DOD Mission Area: 522 - Environmental and Life Sciences (ED) | Budget Activity: 1 - Technology Base

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06HT, Laboratory Support.

A. (U) Project Description. This project provides for the operation of the Air Force Human Resources Laboratory (AFHRL), Brooks AFB, TX, including pay and related costs of civilian scientists and support personnel, travel, transportation, rent, communications, maintenance, procurement of supplies and equipment, and contractor support services. It also funds civilian salaries, travel, and supplies for personnel at the Aeronautical Systems Division, Wright-Patterson AFB, OH, who provide procurement support to AFHRL. The laboratory performs research and development in manpower and force management, weapon systems logistics, maintenance and technical training, and air combat tactics and flying training in support of immediate or potential needs of Air Force operational systems. This project supports and complements all projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602206F  Title: Civil Engineering and Environmental Quality
DOD Mission Area: 522 - Environmental and Life Sciences (ED)  Budget Activity: 1 - Technology Bas

1. (U) **RDT&E RESOURCES (PROJECT LISTING):** ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 6,345 | 6,640 | 5,541 | Continuing | N/A |
| 1900 | Environmental Quality Technology | 3,800 | 2,920 | 2,404 | Continuing | N/A |
| 2673 | Civil Engineering Technology | 2,545 | 3,720 | 3,137 | Continuing | N/A |

2. (U) **BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This Science and Technology program develops technology for civil engineering and Air Force-unique environmental requirements in deploying, operating, and maintaining Air Force weapon systems. This goal is achieved by exploratory development in the areas of: air base facility and utility (e.g., power lines) survivability against conventional weapon threats; post-attack facility & utility repair; aircraft crash rescue and fire suppression; construction and maintenance of airfield pavements; control, detection, and disposal of pollutants and wastes generated during Air Force operations (such as rocket launches, jet engine tests, inadvertent fuel spills, and aircraft maintenance); and waste reduction and remedial actions for Air Force site clean-up activities.

3. (U) **COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY:** ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 6,757 | 5,678 | 6,046 | Continuing | N/A |

EXPLANATION: (U) The change in FY 1987 resulted from transfers from the Defense Environmental Restoration Program central transfer account. The FY 1988 and FY 1989 changes resulted from adjustments to the Air Force Total Obligation Authority.

4. (U) **OTHER APPROPRIATION FUNDS:** Not Applicable.

5. (U) **RELATED ACTIVITIES:** The efforts within this program are of significant interest to the other services and are coordinated through the Joint Services Civil Engineering Research and Development Coordinating Group, which guards against duplicating efforts and works to maximize technology transfer. All Air Force efforts in environmental quality R&D are reviewed annually by the Office of the Under Secretary of Defense for Research and Engineering to preclude duplication within the military services and between the services and other agencies. The Air Force (HQ Air Force Engineering and Services Center) and the Navy (Naval Air Systems Command) have a memorandum of agreement to conduct joint programs for aircraft fire suppression and crash rescue. This program funds efforts that transition for advanced development into PE 0603723F, Civil and Environmental Engineering Technology. Additionally, PE 0601102F, Defense Research Sciences, funds efforts which feed the technical areas in this PE. Frequent technical exchanges between the Air Force

Weapons Laboratory and the Engineering and Services Laboratory preclude duplication. Other related programs are included in PE 0602203F, Aerospace Propulsion, and PE 0602202F, Human Systems Technology.

6. (U) WORK PERFORMED BY: In-house and contractual efforts are conducted by the Air Force Engineering and Services Laboratory, Tyndall Air Force Base, FL. Other government resources are used, including those of the Departments of the Army, Navy, and Energy, the Environmental Protection Agency, and the National Aeronautics and Space Administration. The top five contractors and associated projects are New Mexico Engineering Research Institute, Albuquerque, NM (2673); Applied Research Associates, Albuquerque, NM (2673); Dynamac Corp, Rockville, MD (1900); Resource International, Westerville, OH (2673); and Battelle Columbus Laboratories, Columbus, OH (1900). There are 25 other contractors with a total dollar value of $2.7 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 1900, Environmental Quality Technology. This project characterizes the chemistry of Air Force-generated pollutants and toxic materials, assesses their interaction with the environment, and develops control and cleanup technologies. As environmental regulations become stricter, the technology and procedures used to ensure compliance become more expensive and complex. This project conducts research to reduce the cost and increase the effectiveness of technologies that protect the environment. New and future Air Force fuels and chemicals, such as jet engine and rocket fuels, are monitored in this project in order to anticipate and prevent environmental problems from occurring and to prevent delays in testing and fielding weapon systems. FY 1987 Accomplishments. The following work was completed: laboratory-scale development of a procedure that speeds the regulatory approval of using Air Force incinerators to safely dispose of hazardous wastes; determination of the characteristics that objectively indicate when to replace aircraft parts cleaning solvents, resulting in longer use of the solvents and reduced amounts of hazardous wastes; updating a hazardous gas dispersion model with information on toxic gases which are denser than air; and fundamental studies on the factors governing the formation of soot in a laboratory combustor, which simulates jet engine combustion. FY 1988 Program. The following will be completed: characterization of the significant environmental interactions of toxic hydrazine fuels released into the atmosphere, such as during refueling of rockets; and studies of an instrument that accurately measures hydrochloric acid in the cloud formed during rocket launches (over 15 tons of the corrosive material is generated by a Titan 34D rocket). The following will be initiated: research into the photo-chemistry of chemicals released during jet engine operations, permitting the determination of the impact of aircraft operations on local air quality; studies on the environmental impact of new solid and liquid rocket propellants; and laboratory-scale testing on methods to reduce the amount of hazardous waste generated from the life cycle testing of bullets containing depleted uranium (the uranium increases armor penetration, but the fragments contaminate large amounts of sand in the firing pits). FY 1989 Planned Program. The following will be completed: two fundamental studies on the use of fuel additives to reduce the air pollution from particulate emissions generated during jet engine maintenance tests; design specifications of a combustor that destroys contaminated liquid rocket fuels and complies with standards for nitrogen oxide, a chemical formed during the burning; updating an aircraft emissions model to support environmental impact statements for low altitude flight training operations; and research on marker compounds that identify the source of fuel spills, proving or relieving Air Force responsibility for the cleanup. The following will be initiated: laboratory-scale development of a field test to determine the presence of asbestos in building materials;

characterization of new rocket fuels containing beryllium, which forms a hazardous product in soils and groundwater; and development of cost-effective techniques to reduce or control volatile organic compounds, which are ozone-depleting chemicals generated during most Air Force industrial operations, such as painting aircraft.

B. (U) Project: 2673, Civil Engineering Technology. This project provides a technology base to identify problems and develop solutions for current and future Air Force systems in the areas of survivable structures and utilities, airfield pavements, and fire suppression. The facility and utility research exploits new materials and construction techniques to improve survivability against increasingly accurate and powerful conventional weapons. The airfield pavement research analyzes the wear and failure mechanisms of runways to develop improved materials for repairing and recycling activities. The fire research develops new fire suppression agents to respond to advanced fuels and materials used in Air Force weapon systems. FY 1987 Accomplishments. The following work was completed: development and validation testing of a fire extinguishing agent for fires involving magnesium; a study of a material, added during pavement recycling, that increases the durability of asphalt; and research on small-scale modeling of layered pavements, centrifuge testing techniques, and centrifuge modeling of penetration phenomena. Scaled testing in the centrifuge provides data that dramatically reduce R&D costs. FY 1988 Program. The following will be completed: investigation of high strength concrete properties resulting in a material that can be used in slabs placed next to a building that cause a weapon to detonate prior to impact on the building; development of cheaper and more reliable gages that measure shock wave acceleration near explosions during structures tests; and investigations of the response and failure of the layers of aggregate underneath runway pavements subjected to high aircraft landing gear loads. The following will be initiated: analysis of structural elements that fail from close-in explosions of conventional munitions, thereby reducing the design safety factor; evaluation of methods to assess post-attack damage to facilities; studies of the effects of moisture on pavement performance; and development of a fire suppression agent for aircraft composit material fires (existing agents either can't extinguish the fire or react adversely with the materials). FY 1989 Planned Program. The following will be completed: development of a microcomputer program to rapidly analyze the structural integrity of a damaged facility; studies of post-attack damage assessment of facilities; and development of a foam that can extinguish various types of fires using 50% less foam. The following will be initiated: development of advanced structural modeling technologies to reduce facility design costs; and development of a chemical that will mix with spilled fuel to impede burning; and development of a substitute fire suppression agent to replace current agents that can deplete ozone in the atmosphere.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602302F Title: Rocket Propulsion
DOD Mission Area: 523 - Engineering Technology (ED) Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 37,972 | 38,423 | 39,152 | Continuing | N/A |
| 06RL | Laboratory Operations | 12,127 | 12,890 | 13,157 | Continuing | N/A |
| 2864 | Interdisciplinary Space Technology | 2,181 | 4,637 | 4,637 | Continuing | N/A |
| 3058 | Space Propulsion Technology | 6,926 | 8,034 | 8,138 | Continuing | N/A |
| 3059 | Ballistic Missile Propulsion Technology | 3,291 | 2,100 | 2,000 | Continuing | N/A |
| 3148 | Air-Launched Missile Propulsion Technology | 4,453 | 3,231 | 2,520 | Continuing | N/A |
| 5730 | Multiple Applications Technology | 8,994 | 7,531 | 8,700 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program exploits new concepts and techniques for rocket propulsion and interdisciplinary space technology. Work is accomplished in laboratory or bench-scale tests to prove the feasibility of new technologies before starting larger scale demonstrations. The goal is to provide increased mission capability, more cost effective weapons, and more reliable, maintainable systems. Technology products from this program help to meet the need to improve the utilization of existing launch vehicles and deliver more munitions at longer ranges. The program also provides for the management and support of the Air Force Astronautics Laboratory at Edwards Air Force Base, CA. The efforts in this program do not duplicate tasks conducted under the Strategic Defense Initiative.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 38,251 | 43,339 | 44,283 | Continuing | N/A |

EXPLANATION: (U) The differences in FY 87 and FY 88 were due to Congressional reductions. The FY 89 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Military Construction: Funds | 5,500 | 0 | 17,800 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: Technology base activities in this program are related to National Aeronautics and Space

Administration (NASA), Navy and Army programs. Coordination is accomplished through the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee, by the Space Technology Interdependency Group (NASA and Air Force), and through working-level meetings and inter-service committees. All reports and outputs are coordinated through a central data base under the Chemical Propulsion Information Agency. This exploratory development program provides the technology base for advanced technology demonstration under PE 0603302F, Space and Missile Rocket Propulsion.

6. (U) WORK PERFORMED BY: The Air Force Astronautics Laboratory, Edwards Air Force Base, CA, manages this effort. The in-house efforts are conducted at numerous active experimentation areas to evaluate space propulsion, propellants and ingredients, ballistic performance of test motors and propellants, and new composite materials for motors and space applications in sub- and full-scale tests. The top five contractors in FY 1988 are Aerojet General, Sacramento, CA, (Projects 3058, 3059, and 5730); United Technologies, Chemical Systems Division, Sunnyvale CA, (Projects 3058, 3059, 3148, and 5730); Morton Thiokol, Brigham City, UT, and Huntsville, AL, (Projects 3059, 3148, and 5730); Rockwell International Rocketdyne Division, Canoga Park, CA, (Projects 2864, 3058, 3059, and 5730); and Atlantic Research Corporation Gainesville, VA, (Projects 3058, 3059, 5730, and 3148). There are 40 other firms with contracts totaling $8.1 Million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2864, Interdisciplinary Space Technology. This project integrates key propulsion and non-propulsion disciplines to develop enabling technology for future Air Force space systems. Technologies are being developed in three sub-thrusts: spacecraft enabling technology, spacecraft operational logistics, and space-defense technology. In FY 1987, we conducted an experiment to demonstrate the feasibility of a liquid droplet radiator for high-power systems with a projected 75 percent weight reduction from current radiators. Liquid droplet radiators will enable spacecraft with high power requirements to dissipate large amounts of waste heat with compact, lightweight radiators. We demonstrated a computer control method of maintaining delicate space-structure shapes during orbital operations. We also finished buildup for a shuttle mid-deck experiment that will provide fundamental information on liquid propellant behavior heeded to design equipment for propellant transfer operations in a zero-gravity environment. The impact of the FY 1988 Congressional reduction was to slow some technologies for advanced spacecraft, such as imbedding sensors in structures to interactively control large, fragile structures. An FY 1988 liquid droplet radiator experiment will demonstrate a working-fluid collector in zero-gravity. The collector is required to recapture the working fluid after it has been sprayed from the droplet generator and the waste heat has been radiated to space. Work on multilayer insulation technology will verify the techniques required to produce a high number of layers of insulation that will enable long-term passive or active storage systems for cryogenic propellants or coolants. The storage systems will extend the life of spacecraft that use cryogenic fluids. FY 1989 work will include continuing the study of methods to control the deployment of fragile space structures such as large antennas, conducting measurements in space of contamination from fuel venting, and transitioning of multi-layer insulation technology to new tank concepts for advanced spacecraft. We will also continue work on advanced heat-transfer technology to confirm the feasibility of reducing the weight of spacecraft radiators by ninety percent.

B. (U) Project: 3058, Space Propulsion Technology. This project provides technology required for: survivable, reliable operations in space in both routine and war-fighting scenarios; cost-effective access to all orbits; and

survivable, on-demand access to space. Areas of investigation include propulsion for satellite orbit transfer and maneuvering for survivability, launch-vehicle propulsion, and exhaust plume signatures technology. Work will continue on technology to lower engine weight to reduce the cost to orbit and to enable reusable systems. Longevity-extending technologies will allow reusability and will enable flexible operational concepts such as space basing. In FY 1987, we completed major feasibility demonstrations for potential launch-vehicle improvements and orbit-transfer propulsion systems. Advanced materials for launch vehicle engines and feed systems can save 15 percent of the engine weight. This could translate to an increase in Shuttle payloads of 6 percent for an Eastern Test Range launch or 12 percent for a Western Test Range launch. A 30 kilowatt power conditioner (used to supply power) was designed and fabricated to demonstrate performance increases in a representative size (30 kilowatt) arcjet engine. We continued work to reduce engine weight and demonstrate new propulsion concepts such as arcjets, solar/thermal engines, and nuclear engines. We completed component design for the low-thrust cryogenic engine (XLR-134) in preparation for testing. An advanced arcjet engine design approach was established to demonstrate ten times the lifetime of the previous version and upgrade the performance of critical components. Completion of new laboratory facilities allows component demonstrations of solar collectors and solar/thermal thrust chambers for satellite orbit transfer propulsion. Studies will continue to define a nuclear propulsion system that could be used for reusable orbit transfer propulsion. Due to FY 1988 fund reductions and technical problems, we terminated the XLR-134 engine program in FY 1988. In addition, reductions to PE 0603302F precluded our planned transition of the XLR-134 to that program element. In FY 1988, we will complete work feed systems for storable propellants and cryogenic propellants for satellite orbit transfer propulsion. Progress on arcjet thrusters will include completion of work on the power conditioning circuit and key thruster elements to allow complete breadboard engine firings at 30 kilowatts. Launch vehicle engine technology programs will conclude, providing light-weight engine components to reduce engine weight. In FY 1989, large, low-cost titanium tanks for storable propellants will be demonstrated that will enable weight reductions for propellant feed systems for satellite propulsion. Lightweight engine component technology for launch vehicles will be integrated in an ultra lightweight engine program that will demonstrate the feasibility of a new class of engines. Studies will begin to identify low-cost, expendable engine concepts that may provide an economic alternative to high-unit cost, reusable engines for launch vehicles. In addition, efforts will continue to transition arcjet thrusters to advanced technology demonstrations for orbit-transfer propulsion. The 30 kilowatt arcjet thrusters will be demonstrated at the component level and transfered to an advanced technology demonstration of complete engine technology for reusable satellite propulsion and maneuvering.

C. (U) Project: 3059, Ballistic Missile Propulsion Technology. This project develops technology to provide flexible basing, increased range, and enhanced survivability for future systems. These technologies could be used in a small, mobile ballistic missile to increase range or payload by 30 percent. This project has identified manufacturing variables which affect the operational life of ballistic missiles. Control of these variables will allow increased life of a missile in a flexible basing mode. We are developing new analytical techniques that more accurately determine propellant properties to improve designs and reliability of future systems. This project has also identified new composite material combinations to reduce the motor case weight and tested three-dimensional carbon/carbon nozzle materials to increase reliability of the system. In FY 1987, we investigated how motor deformation during firing affects the combustion process and performance. Work also began on a fast-burning propellant for a fast launch intercontinental ballistic missile concept to improve survivability. Investigations will continue into the effects of processing variables on the integrity of composite motor cases and nozzles, and failure mechanics of two-

and three-directional filament-wound materials in order to prevent motor failures. In FY 1988, we will complete characterization of a new x-ray technique to find and assess nozzle flaws and transition it to the Small ICBM program. In addition, we began a small, mobile missile, service life program to provide information to accurately predict the age life of motors. Our FY 1989 efforts will include non-destructive evaluation techniques to detect motor flaws to prevent serious failures during firing, new processing techniques to eliminate motor processing variables, and demonstration of new propellants and components for advanced ballistic missiles. We also plan to complete some preliminary propellant development and define a propulsion concept that will support a fast-launch ICBM concept.

D. (U) Project: 3148, Air-Launched Missile Propulsion Technology. Technology in this project can be applied to both strategic and tactical missiles. Strategic applications strive to maximize stand-off range to improve aircraft survivability and weapons penetration to the target through the use of variable-trajectory capability. Tactical applications emphasize the need to minimize the rocket motor plume signature to enhance launch aircraft survivability while improving the range for air-to-surface applications. Minimum and reduced smoke propellants are being developed with lower hazards and without the performance degradation usually associated with minimum-smoke propellants. These low-hazard, high-performance propellants have great utility in Europe, where safety requirements for missile storage seriously impact operations and reduce on-hand quantities when high-hazard munitions are used. These efforts support joint-service insensitive munitions efforts. Efforts to measure plume characteristics will enable us to build better detection devices for enemy missiles or devise countermeasures to confuse enemy detection devices. Component assurance activities allow better understanding of how rocket motors age during their lifetimes to predict the useful life of a motor and prevent failures in operational missiles. An ongoing contract is investigating non-circular composite motor cases. Very high altitude targets and strategic missiles that must penetrate defenses or maneuver for relocatable targets may demand non-circular motor cases and propellants that deliver very high thrust with low radar-signature plumes. We began a joint effort with Ogden Air Logistics Center to experimentally verify service life prediction by accelerating the age of newer motors in the laboratory to match older motors and then confirm the results by dissecting and testing the propellant from both motors. Also, we demonstrated high-temperature resins that are suitable for further development in composite motor cases that can maintain structural capability during sustained supersonic flight conditions on high-performance aircraft. In FY 1987, we demonstrated a new low-hazard, high performance propellant in an operational motor configuration (Sidewinder). We collected a large amount of experimental data on the infrared, ultraviolet, and visable light components of rocket plumes to validate and update computer programs that will predict plumes. Also in FY 1987, we completed two years of aging Advanced Medium-Range Air-to-Air Missile (AMRAAM) propellant that provided data to support service-life predictions for AMRAAM. We began a program to assess the cumulative damage a composite-case motor would undergo due to handling, transportation, and extreme temperatures that will conclude in FY 1990. In response to the Congressional reduction in FY 1988, we eliminated most new efforts but will maintain our joint-service efforts and ongoing efforts that support operational systems. We curtailed low-signature propellant work and our application of composite technology to light-weight rocket motor components. In FY 1988, we will begin a propellant program to improve the energy of minimum-smoke propellants. We will begin advanced concept definition programs to provide propulsion options for weapons that will require very high velocity and a high degree of lateral maneuvering in order to survive the terminal defenses of some targets. We will begin to address the deleterious affects of sound energy on a rocket motor due to the aircraft's flight. Also in FY 1988, we will select and prepare laboratory samples of composite cases and propellants in our composite case cumulative damage program to

form the basis for predicting the damage response in a simulated, full-size motor. In FY 1989, we plan to fabricate and test the simulated, full-size motors in the cumulative damage program to confirm the predictions of damage response before planning to test in a motor configured for a missile. We will begin a program to lower the fabrication cost of motors that have risen whenever the performance was increased. We will conduct a follow-on to the advanced concepts definition program that will begin to develop the best of those ideas. Also in FY 1989, we expect to complete the aging and test firings of a new, reduced-smoke propellant that has more energy and less visible plume signature than any other comparable propellant.

E. (U) Project: 5730, Multiple Applications Technology. This project explores technologies that have applications to more than one area of propulsion. We need to improve systems reliability by alleviating failures or low performance in systems such as solid-propellant motors for orbit-transfer systems and air-launched or ballistic missile motors. The technologies include better understanding of the effects of combustion on performance, introducing new propellant ingredients, determining factors limiting service life, and investigating the feasibility of advanced propulsion concepts. New concepts and innovative approaches to propulsion needs are a major focus of this project. Work began in High-Energy-Density Materials, a field which offers tremendous potential advances in propellant performance. These propellants could revolutionize the propulsion performance of conventional chemical systems with excited-state propellants that could double the payload of current space launch vehicles. In FY 1987, we transitioned our reduced cost propellant processing technology to Peacekeeper and Small ICBM. We documented the probability that electrostatic discharge could ignite various types of propellants. We identified two theoretical molecules, in the High-Energy-Density Materials program, that merited further study due to their potential high energy. In FY 1988, we will continue work on High-Energy-Density Materials to study the theory and methods of creating materials in an excited-energy state. We will continue work to provide improvements in liquid propellant rocket engines and composite-case solid rocket motors. Flow of hot exhaust gas and heat transfer in rocket nozzles will be studied to improve the performance of propulsion for orbit-transfer vehicles. Better understanding of flexible cases for solid rocket motors will allow a greater amount of propellant to be loaded into motors and better predictions of service life. Our FY 1989 work includes completing fundamental research to define processing, curing, and aging interactions of solid propellants to accurately predict service life. High-Energy-Density Materials work will continue in the phase that concentrates on creating excited-state materials. We will perform tests to confirm the predictive analysis of combustion instability will provide a tool to avoid serious problems during solid rocket motor operation. Efforts will continue to improve the performance of components, propellants and the integrity of solid propellant rocket motors.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06RL, Laboratory Operations

A. (U) Project Description: This project funds management and support of the Air Force Astronautics Laboratory (AFAL), Edwards Air Force Base, CA. The AFAL is responsible for exploratory and advanced development associated with propulsion for air-launched and ballistic missiles and space systems. This project provides support for an in-house program covering the following areas: rocket propulsion phenomenology investigations, new concepts feasibility evaluation and systems support to Air Force Systems Command product divisions. It covers salary and travel of civilian

scientists, engineers and supporting personnel; transportation, rent, communications and utilities costs; and procurement of supplies, equipment, and contractor support services. This project supports and compliments all projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602601F
DOD Mission Area: 521 - Electronics & Physical Sciences (ED)

Title: Advanced Weapons
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 37,990 | 34,846 | 34,685 | Continuing | N/A |
| 06WL | Lab Operations | 19,415 | 18,526 | 19,100 | Continuing | N/A |
| 2007 | Nuclear Safety | 698 | 714 | 762 | Continuing | N/A |
| 2218 | DEW Tech Assessment | 1,660 | 1,543 | 1,800 | Continuing | N/A |
| 3326 | Laser Applications | 6,207 | 5,659 | 5,600 | Continuing | N/A |
| 5797 | Adv Weapons Concept | 7,780 | 6,804 | 5,800 | Continuing | N/A |
| 8809 | Nuc Surviv/Hard Tec | 2,230 | 1,600 | 1,623 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology effort advances the state of the art in directed energy weapons (DEWs) such as high energy lasers and high power microwaves and in nuclear survivability. DEWs are of great interest because they will allow long range, near instantaneous kills of many types of targets. These technologies will be used not only for weaponization but also to determine the effects of these types of weapons on potential targets. This technical effort will also support studies to ensure that our nuclear weapons can be handled and operated safely. Management and support of the Air Force Weapons Laboratory at Kirtland Air Force Base, NM, is also included. The efforts contained in this program do not duplicate tasks being conducted under the Strategic Defense Initiative or by the Defense Nuclear Agency.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 43,352 | 37,027 | 37,304 | Continuing | N/A |

EXPLANATION: (U) FY 1988 reduction resulted from congressional action. The FY 1989 reduction accomodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Military Construction Funds: | 8,650 | 7,400 | 10,900 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: Nuclear weapons efforts are coordinated closely with programs funded by the Defense Nuclear Agency PE 0602715H. Technology developed through this program element supports nuclear survivability work for Advanced Strategic Missile Systems, PE 0603311F, and Air Force Systems Survivability (Nuclear Effects), PE 0604711F. Exploratory laser development supports the Air Force Advanced Radiation Technology PE 0603605F. Project 3326 and Project 5797 are

coordinated closely with Navy PE 0602101N, Directed Energy Weapons, and Army PE 0602307A, Laser Weapon Technology. Within Project 5797, the High Power Microwave (HPM) program is closely coordinated with Air Force PEs: 0602202F, Aerospace Biotechnology; 0602204F, Aerospace Avionics; 0603743F, Electronic Combat; 0603749F, Command, Control, and Communication Countermeasures Advanced Systems; 0604711F, Systems Survivability; and 0604747F, Electromagnetic Radiation Test Facilities. Beginning in FY 1988, applicable HPM technology development transitions to PE 0603605F. There is close coordination between this PE and Directed Energy Weapons, Strategic Defense Initiative (SDI) PE 0603221C. Project 2218 is coordinated with lethality and target hardening work in SDI 0603224C, Survivability, Lethality, and Key Technologies. This coordination ensures that the Air Force makes maximum use of SDI technology applicable to non-SDI Air Force efforts.

6. (U) WORK PERFORMED BY: The Air Force Weapons Laboratory at Kirtland Air Force Base, NM, manages all of the work performed under this PE. The top five contractors for FY 1987 were RDA, Marina Del Rey, CA (8809); Martin Marietta Aerospace, Denver, CO (3326); Maxwell Labs, San Diego, CA (5797); Rockwell International Corp, Rocketdyne Division, Canoga Park, CA (3326/5797) and Mission Research Corp, Santa Barbara, CA (5797/8809). There are 49 additional contractors with a contract value of $5.1 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2007, Nuclear Safety. This project verifies designs of new and modified nuclear weapon systems against Air Force nuclear safety and security design criteria; maintains a technology base and develops nuclear safety and security design and evaluation criteria; and provides a technical nuclear safety analysis (TNSA) for each Nuclear Weapon System Safety Study. It also supports safety requirements for other uses of nuclear materials by the Air Force and provides technical assistance to other major commands to determine if the design or modification of a nuclear weapon system affects positive control of nuclear materials. System nuclear safety and security studies are performed in phases as the system develops and changes over its lifetime. Preoperational TNSAs are performed prior to system initial operational capability. Operational TNSAs are performed as the system reaches Full Operational Capability. Nuclear certified systems undergo an operational nuclear safety and security review and inspection every two years. In FY 1987, an operational safety review was performed on the B-52/B53 Bomb and a special safety study performed on F-111E. An operational review observed day-to-day operations and ensured that operations were in accordance with the nuclear surety program of the F-16A/B/C/D. A study of the initial analysis of Small Intercontinental Ballistic Missile (SICBM) design concept, a B-52H/Advanced Cruise Missile System Special Safety Study, and a F-16A/B Special Operational Capability Upgrade Study were performed. Additional activities included US & NATO tactical aircraft co-location and dispersal to hardened aircraft shelter and the recommendation for certification of mechanical aspects of the weapon storage and security system. Activities for FY 1988 include an initial nuclear safety study on the ICBM system and operational Nuclear Safety Reviews and inspection of the Ground Launched Cruise Missile system, FB-111, F-16C/D and B-1B aircraft systems, and the PEACEKEEPER missile system. In FY 1989, planned efforts include the initial nuclear safety study on the Short Range Attack Missile II system and operations reviews and inspections of the B-52/ACM System, F-16A/B, F-111E, and PA-200 TORANADO aircraft systems.

B. (U) Project: 2218 Directed Energy Weapon Technology Assessment. This project assesses directed energy weapons (DEW) lethality against foreign targets and the vulnerability of United States strategic and tactical systems to DEWs. It further provides systems assessments of DEWs to evaluate their operational utility in specific Air Force missions. The lethality assessment effort includes theoretical and experimental work with a variety of materials and countermeasures concepts. The systems assessment effort plans, coordinates, and performs studies and analyses of directed energy weapon (DEW) concepts to establish system performance characteristics and requirements. This includes examination of potential applications and the determination of feasibility and effectiveness of mission performance. Preliminary engineering studies are performed on advanced weapons concepts to determine impact on subsystem and component technology development. The system analysis effort investigates how to best use DEWs and determine what technology improvements are needed. During FY 1987, laser lethality was established for short wavelength lasers against satellite materials using the chemical oxygen-iodine laser. The data were combined with satellite pressure vessel damage data to establish threshold damage conditions. Data were also obtained for higher intensities than previously investigated to understand variations in laser beam coupling as a function of intensity. High power microwave tests were completed on the F-16 inertial navigation system to establish damage thresholds. The Ground Based Laser Uplink Study systems assessment was completed to compare five ground based laser concepts for the antisatellite (ASAT) mission. This study has been briefed throughout the Air Force and OSD. It supports current OSD investigations of technology alternatives. An evaluation of the comparative performance of ground based lasers, space based lasers, and space based neutral particle beam weapons in the ASAT mission was completed. The 40 kilowatt carbon-dioxide laser, operated by laboratory personnel, was used to evaluate hardened spacecraft materials. Code developments were continued to improve analysis capabilities for high power lasers and high power microwave weapons. A cost model was completed for Phased Integrated Laser Optics Technology and for five kinds of ground based laser technologies. In FY 1988, lethality experiments will investigate four new laser damage modes for satellite negation. These tests will culminate in FY 1989 with large scale tests on the vulnerability of satellite subsystems. This will be followed by a comprehensive satellite vulnerability assessment in FY 1990. High power microwave testing will be initiated against aircraft guidance systems and missile subsystems in FY 1988. These tests will be completed in FY 1989 and will lead to an improved analytic capability for the prediction of subsystem vulnerability to high power microwaves in FY 1990. Systems assessments will provide more detailed cost trades for ground based laser concepts in FY 1988 resulting in optimization of system concepts in FY 1989. Technology trades will be performed for neutral particle beam devices in FY 1988. Unique high power microwave codes are being improved in FY 1988 to permit more accurate calculations of atmospheric propagation and near-field antenna patterns. Innovative system designs for tactical weapons concepts will be initiated in FY 1989.

C. (U) Project: 3326, Laser Applications. This project examines the technical feasibility of lasers as weapons for Air Force mission requirements. This includes studying short wavelength chemical laser device concepts, developing fabrication technology for HEL optical components, analyzing and investigating advanced beam control and beam generation concepts, and investigating HEL phenomenology. Advanced chemical lasers may provide an attractive, high efficiency alternative to other laser devices for airborne, space based and ground based systems. A revolutionary technique for single pulse operation of a chemical oxygen iodine laser was demonstrated in FY 1987. This will lead to a repetitively pulsed demonstration in FY 1988. Promising concepts for visible (short wavelength) chemical lasers have been identified and are being pursued theoretically and through in-house experiments. A visible chemical laser demonstration is

anticipated in FY 1989. Development of optical components for short wavelength/near-infrared lasers will continue. One of the most critical needs is to quickly correct the laser beam for any nonuniformities caused by the lasing medium, nonperfect mirrors, moving mirrors, etc. Several techniques are being studied. A revolutionary concept for beam correction, beam pointing/steering combining several beams into a single beam, and incorporating information onto the beam, is being developed. This concept, known as nonlinear optics (NLO), will build on the accomplished conceptual demonstrations of beam steering and beam sharpening. These demonstrations transitioned to PE 0603605F, Advanced Radiation Technology in FY 1988, with other NLO concepts being explored at a more fundamental level in PE 0602601F.

D. (U) Project: 5797, Advanced Weapons Concepts. This project explores nonconventional, non-nuclear and nuclear weapons concepts using innovative technologies. Primary areas of research are: high power microwaves (HPM), high energy plasmas, high energy pulse power, intense relativistic electron beams, nuclear power technology, and conceptual and feasibility studies of nuclear weapons requirements. High Power Microwaves (HPM): The Air Force High Power Microwave Technology Program involves research on device development technology; the upgrade of test environments/facilities to provide controlled, reproducible electromagnetic fields; expanded effects database development, in conjunction with the national HPM testing community; the development of a standard test methodology; and research in several areas of phenomenology. In FY 1987, a National HPM Test Advisory Group was informally established to review all aspects of upcoming series of major subsystem and system tests that support susceptibility/vulnerability database development. Other efforts examined the investigation of hardening technologies, tests of selected foreign assets, and lethality experiments. Among the assets tested in FY 1987 were the AIM-9L, selected communications subsystems, the F-16 inertial navigation subsystem and a foreign missile. In FY 1988, HPM testing will continue on the AIM-9L and new testing will include the fly-by-wire F-16 flight control subsystem and a satellite communication substation. Higher power, field transportable devices developed during FY 1987 allow larger systems to be tested in FY 1988 and FY 1989. Investigation of phase locking of multiple HPM sources, mode conversion technology, antenna coupling and propagation issues will also be conducted. During FY 1988 and FY 1989 increasingly larger, more complex Air Force systems will be tested to add to the national susceptiblility database. In late FY 1989, the High Energy Microwave Laboratory (HEML) will be completed and used to test aircraft sized assets and systems that have undergone preliminary hardening. High Energy Pulse Power: In FY 1987 efforts began to develop a repetitive pulser for high power microwaves. The ultimate goal is to develop a 10 shot burst capability at 10 Hertz with microsecond pulses. A 5 shot repetitive-rate test bed is planned for June 1988 producing 0.4 million watts at 10 Hertz. Also in FY 1987, high energy density plasma flow switch experiments, conducted on SHIVA star, resulted in a 3 trillion watt pulse using a charge voltage of only half the bank's capacity. In FY 1988 the goal is to produce a 10 trillion watt pulse. This is an important milestone on the path to a 100 trillion watt fusion experiment. This power level could result in the fusion parameters necessary for powering fourth generation, "exotic" nuclear pumped weapons in a laboratory environment. High Energy Plasmas: In FY 1987 microgram magnetized plasma rings (compact toroids, or CTs) were accelerated to 5,000 kilometers per second in a collaborative effort with Lawrence Livermore National Laboratory. In FY 1988, CTs will be produced on the SHIVA Star capacitor bank. In FY 1989 CT acceleration experiments are planned; calculations show CT velocities of 10,000 kilometers per second and power levels of 1,000 trillion watts are possible if these experiments are successful. Nuclear Power Technology: Terrestrial and space nuclear reactor program studies were conducted during FY 1987. FY 1987 efforts in advanced nuclear power technology included investigations using liquid metals. Modeling studies of reactor thermodynamics and kinetics for advanced reactor design concepts were initiated and will be completed in FY

1988. Technology efforts have focused on developing spacecraft power in the 5-40 kilowatt electrical range. Compact space reactor technologies that meet near term Air Force requirements will be studied in FY 1988 and FY 1989. Nuclear Weapons Requirements Studies: Nuclear weapons requirements studies completed in FY 1987 include conceptual studies on strategic relocatable target weapons using both conventional and advanced nuclear effects as well as feasibility studies for alternative warheads for the Small Intercontinental Ballistic Missile and for earth penetrating weapons (EPW). The EPW study will be completed in FY 1988 and a conceptual study on hypersonic vehicles will begin. A feasiblity study on an upgraded Short Range Attack Missile or tactical air to surface missile will also be initiated in FY 1988. In FY 1989, three nuclear weapons requirement studies will be conducted.

E. (U) Project: 8809. Nuclear Survivability and Hardening Technology. This project develops nuclear survivability technology for Air Force systems. This includes design criteria, specifications, standards and design handbooks, and methods to alleviate the effects of nuclear weapons on Air Force systems. Nuclear survivability criteria set the upper limits of nuclear environments in which Air Force systems must survive and are based on mission requirements, hostile threats, nuclear environment system response, operational employment, and hardening technology cost factors. In FY 1987, effectiveness characterizations of different classes of EPW were completed. Radiation tests of radiation-hardened transistors were initiated and test of sample composite (graphite-epoxy) materials were included. A preliminary threat analysis study of the rail-garrison basing mode was completed. The first integrated optics radiation response data for an integrated optics device were also obtained in FY 1987. In FY 1988, the nuclear criteria for the Advanced Tactical Fighter and for the PEACEKEEPER/Rail Garrison will be completed. The first Air Force-wide communications disruption scenario will be established in FY 1988, as well as characterizations of satellite materials. Planned testing in FY 1988 and FY 1989 include cryogenic radiation tests on gallium-arsenide transistors and radiation tests of 10.6 micron fiber-optic cables. Thermal property characterization of composite materials will be completed in FY 1988. Starting in FY 1988, technical assessments of existing and new nuclear warheads modified and/or designed for earth penetration will be conducted. For FY 1988-91, continued definition of the high altitude electromagnetic pulse (EMP) threat will be studied. Nuclear systems survivability studies, which started in FY 1986, will continue on through FY 1992. These studies will investigate alternate concepts to define, develop, and establish the requirements for present and future Air Force weapon systems. Resulting requirements will enhance system performance in critical missions. Radiation tests are planned in FY 1988 and FY 1989 on emerging semiconductor devices for use in advanced Air Force systems. New methods will be developed to assist in the definition, development, and establishment of hardness requirements for nuclear blast and thermal and radiation effects of present and future Air Force weapon systems. The goal will be to enhance our weapon systems' performance in critical missions. In FY 1988 work will continue on defining advanced structural materials for nuclear hardening and determining the effects of nearby nuclear detonation on structures. Nuclear criteria studies planned for FY 1988 include the following systems: advanced close air support aircraft; Ground Wave Emergency Network; tactical fighters such as the F-16, F-15, A-10, F-111; Interservice/Agency Automatic Message Processing Exchange; and new Tactical Air Command and Strategic Air Command reconnaissance aircraft and satellites. In FY 1988 and FY 1989, radiation damage mechanisms important for low temperature microelectronics applications, such as infrared sensors, will be studied. Our current space nuclear environment predictive capability is very uncertain. With the increasing emphasis being placed on advanced systems for enhanced nuclear survivability these uncertainties must be greatly reduced. New models for nuclear effects in space will be developed during the period FY 1988 through FY 1990 to alleviate this problem. In FY 1989 nuclear criteria studies will include the update

of the KC-135 Tanker Single Integrated Operation Plan, National Aerospace Plane, and Advanced Time Sensitive Communications Systems. Space irradiated integrated optics will be developed as space shuttle experiments in FY 1990-91.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06WL, Laboratory Operations

A. (U) Project Description: This project covers management and support of the Air Force Weapons Laboratory (AFWL), Kirtland Air Force Base, NM. The AFWL is responsible for exploratory, advanced, and engineering development programs associated with nuclear and other nonconventional advanced weapons, including studies of effective delivery techniques and hazards of these weapons. This project provides for the pay and related costs of civilian scientists, engineers, and supporting personnel in the AFWL; travel and other transportation costs; costs for AFWL personnel training, facility projects, and communication lines; rental and maintenance costs for administrative equipment; non-technical contractual services; and procurement of administrative supplies and equipment. This project supports and complements all other projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602602F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Conventional Munitions
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 39,301 | 40,587 | 44,007 | Continuing | N/A |
| 06AL | AF Armament Laboratory Operations | 11,556 | 13,133 | 13,425 | Continuing | N/A |
| 2068 | Advanced Seeker Technology | 9,261 | 12,343 | 12,282 | Continuing | N/A |
| 2502 | Ordnance Technology | 10,819 | 8,061 | 9,800 | Continuing | N/A |
| 2543 | Weapon Effectiveness Methodology | 2,313 | 1,500 | 1,500 | Continuing | N/A |
| 2567 | Aeromechanics Technology | 5,262 | 5,550 | 7,000 | Continuing | N/A |
| 2946 | Chemical Warfare Technology | 90 | 0 | 0 | 0 | 2,800 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This science and technology effort advances the Air Force technology base for air-delivered conventional weapons to support the nonnuclear missions of the Tactical Air Forces, Strategic Air Command, and the Special Operations Forces. The program includes: (1) design and demonstration of advanced air-delivered munitions, warheads, explosives, and fuzes; (2) guidance and flight control to assure weapon delivery; (3) improved aircraft guns and ammunition; (4) advanced low-drag high performance airframes, conformal/internal carriage techniques, and improved submunition dispensing concepts; (5) modeling, analyses, and evaluation criteria for all efforts; and (6) exploratory development of a wide range of explosives for safety and performance including modeling, laboratory investigation, small scale testing, and qualification for full-scale munitions. This program also funds the management and support of the AF Armament Laboratory (AFATL) at Eglin AFB, FL, and provides fiscal support for the Joint Service Guidance and Control Committee and the Joint Army/Navy/NASA/AF Interagency Propulsion Committee.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 49,884 | 43,041 | 46,846 | Continuing | N/A |

EXPLANATION: (U) The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This is the only AF exploratory development program that provides the conventional munition technology base for the following AF advanced and full scale development programs: 0603307F, Air Base Survivability; 0603601F, Conventional Weapons Technology; 0603363F, Hypervelocity Missile/Advanced Missile Technology Integration; 0603609F, Millimeter Wave Seekers; 0604314F, Advanced Medium Range Air-to-Air Missile; 0604602F, Armament Ordnance

Development; 0604604F, Submunitions Development; 0604609F, Reliability & Maintainability Maturation/Technology Insertion; 0602201F, Aerospace Flight Dynamics; and 0604733F, Surface Defense Suppression. Related Army, Navy and Defense Advanced Research Projects Agency (DARPA) programs include: 0602303A, Missile Technology 0602624A, Weapons and Munitions Technology; 0602618A, Ballistic Technology; 0602332N, Surface/Aerospace Weapons Technology; and 0602702E, Tactical Technology. These related programs are coordinated through formal and informal channels to prevent unnecessary duplication and to maximize the payoff from research and development expenditures. Formal coordination of efforts within these programs has been through Memoranda of Understanding and Agreement with the Air Force Weapons Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Engineering Services Center, Army Missile Command, Naval Weapons Center, Naval Air Systems Command, and DARPA. Additional coordination is accomplished through participation in the following joint service groups: Joint Ordnance Commander's Group, Joint Director of Laboratories Committee, Joint Service Fuze Manager, Joint Service Seeker Working Group, Technical Coordination Program, Tri-Service/Industry Infrared Working Group, Joint Service Guidance and Control Committee, and Joint Conventional Ammunition Program. Joint Army Navy NASA, Air Force Propulsion Hazards Committee.

6. (U) WORK PERFORMED BY: This program is managed by the Air Force Armament Laboratory, Eglin Air Force Base, FL. The major contractors are: Vought Corp, Dallas, TX (Projects 2068, 2502, and 2567); Raytheon Co, Bedford, MA (Project 2068), General Electric Co, Schenectady, NY (Project 2502); McDonell Douglas Astronautics, St Louis, MO (Project 2567); and Lockheed, Sunnyvale, CA (Project 2502). There are 36 additional contractors with a dollar value of $62.3 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2502, Ordnance Technology. This project designs and demonstrates advanced air-launched weapon technology for increased lethality, multiple target kills and reduced delivery aircraft exposure. These efforts provide advanced technology concepts in cluster munitions, kill mechanisms, warheads, explosives, fuzing, and target activated fuzes. In FY 1987 explosively-formed penetrators and self-forging heavy metal fragments were fabricated, tested, and evaluated. Model development for warhead/target interaction and resulting armor debris effects was continued. The breadboard fabricaton, test, and evaluation of defense suppression submunitions and low-cost adverse weather optical proximity fuze designs were continued. Reactive fragmentation kill mechanisms were evaluated against various targets. The insensitive high explosive (IHE) efforts were expanded to include submunitions and missiles. Development of high performance gun barrel concepts were continued. The penetration fuze technology was tested and evaluated against complex, buried, high value targets. Electronic fuze breadboard designs used in high velocity projectiles were tested and evaluated. New penetration techniques to defect extremely hardened underground targets were investigated. In FY 1988, penetration mechanics to defeat buried hardened targets will be further investigated and characterized. Subscale tests of improved warhead cases will be conducted against concrete, rock, and rockrubble targets, and the results will provide the technology base to design warheads to defeat Warsaw Pact targets. Laboratory and field tests will be conducted with shaaped charges and pre-formed penetrators to evaluate advanced materials and improved heavy metal warhead designs. These results will characterize armor penetration properties and will be used to design anti-armor warheads effective against the T-80 follow-on tank. Sled tests of joint AF/Army developed reactive fragment warhead concepts will be conducted. These explosives will be tailored for MK-84 and I-2000 bombs. A full 1.5 hazard classification for these munitions will be the goal of 6.2 explosive development. Candidate IHE formulations will be conducted and

evaluated for transitioning to general purpose bombs. In FY 1989, advanced Warhead penetraton designs will be analyzed and evaluated to characterize effects against advanced armors. This effort will support US capability to defeat projected armor threats with-air-launched weapons beyond the year 2000. Techniques to control trajectories of runway penetrating bombs will be investigated to improve pentration and cratering. Finally, material fracture effects during warhead impact and penetration will be investigated to develop the capability to defeat advanced armor.

B. (U) Project: 2543, Weapon Effectiveness Methodology. This project develops and uses computational techniques and data bases to assess weapon effectiveness against aircraft, mobile targets such as tanks and armored personnel in weapon effectiveness models. The project continued vulnerability studies for Soviet surface-to-air missile (SAM) FY 1987 efforts addressed the vulnerability of the Soviet FULCRUM fighter and implemented physical and functional descriptions of the Soviet cruise missile, the Airborne Warning and Control System aircraft, and the FENCER fighter/bomber. Studies will be completed on the SA-8 radar and the SA-11 SAM systems. SA-10 and SA-12 SAM systems vulnerability studies will continue. Target descriptions and vulnerability assessments will be completed for the North Korean command centers and SAM sites. Vulnerability and effectiveness studies were conducted for the hard target weapon against several hardened command centers and bridges. Physical and functional descriptions of North Korean SAM sites and support facilities, hardened artillery sites and naval facilities were implemented. FY 1988 efforts will complete the comprehensive SAM study, develop improved effectiveness methodology for evaluating advanced submunitions that have guidance and target acquisition capabilities. In FY 1989, new warhead/target interaction simulation models will be designed and the damage effects data base against target components will be maintained and expanded for smart submunitions, reactive warhead materials, heavy metal multi-slug warheads, and controlled detonation warheads.

C. (U) Project: 2567, Aeromechanics Technology. This project develops weapon airframe and carriage technology for streamlined weapons. Streamlining weapons improve aircraft performance by reducing drag caused from attaching weapons to aircraft. Developments will also enable supersonic, low-altitude weapon releases that will greatly increase aircraft survivability. This project also provides the technology base supporting low-cost, small-size, midcourse guidance subsystems for standoff weapons. FY 1987 efforts demonstrated low-drag, advanced missile airframes. Weapon carriage and release technologies that focus on lighter, lower cost, lower maintenance components were developed and incorporated into conformal/internal ejector racks to increase rack performance and reliability. Small, low-cost solid state gyro and accelerometer technology were matured for integration into weapon guidance and flight controls. Distributed system software techniques to increase data processing capacities while reducing size, weight and cost of internal processing hardware was be investigated. FY 1988 efforts demonstrate advanced launchers that can eject missiles carried internally. Advanced weapon airframe technology for efficient hypersonic flight at 100,000 to 400,000 feet will be initiated. The Joint Service tactical ring laser gyro inertial measurement unit (IMU) will be field tested to establish its effectiveness without increasing system costs. The project will also demonstrate techniques to enable faster, more accurate transfer of information between aircraft and missile inertial navigation systems. In FY 1989, the project will evaluate aerodynamic characteristics and develop the data base for advanced, highly maneuverable missile airframes. The project will improve models to assess and predict air flow fields for internal weapon bays and external wing pylons. The development of composite missile airframes capable of efficient hypersonic flight at 100,000 to 400,000 feet will continue. Brassboard development will be completed and a small, low-cost laser gyro IMU providing improved midcourse guidance accuracy at a 50 percent cost savings over current IMUs

will be demonstrated. A low-cost, solid state sensor will be developed to reduce errors in inertial measurement alignments and improve missile midcourse guidance accuracy. This project is developing computational fluid dynamics technology for analysis tools for missiles in free flight and during carriage and release from aircraft. The weapons carriage code will be developed and published in FY 1989.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2068, Advanced Seeker Technology.

A. (U) Project Description: This project develops advanced seeker technology for conventional weapons and advances the technology base for autonomous, all-weather weapons delivery. This effort provides effective precision terminal guidance of advanced weapon systems with increased accuracy and standoff ranges, more precise aimpoint selection, offset aiming for buried hard targets, autonomous target acquisition and terminal guidance for a "launch and leave" capability. This project develops more cost-effective weapon systems by increasing the number of kills per sortie and increasing delivery aircraft survivability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The extended source infrared (IR) target simulator that generates real-time dynamic IR scene was completed. A low-cost tactical laser radar guidance breadboard concept was be demonstrated in captive flight tests against high-value targets, such as airfields, bridges, industrial complexes, etc. The jointly funded AF/DARPA development of the millimeter-wave (MMW) seeker algorithms was be completed and incorporated into an ongoing dual-mode seeker development effort with the Army to provide a dual-mode seeker concept capable of autonomous all-weather attack against fixed and mobile targets. Techniques to autonomously acquire future Warsaw Pact air threats were identified (joint effort with the Navy). Advanced weapon seeker radome and antenna technologies were initiated to take advantage of monolithic designs being developed in basic research efforts.

(2) (U) FY 1988 Program: The joint AF/Army dual-mode seeker concept will be tested and evaluated in laboratory and captive flight tests. This concept combines the precision of imaging infrared (IR) with the adverse weather capability of MMW to enable all-weather, multimode guidance. These tests will validate MMW digital signature models for targets, background clutter, and countermeasures. These efforts will enhance the ability to predict threat signatures and are supported by joint AF/DARPA MMW seeker algorithm developments. Efforts to incorporate artificial intelligence into guided weapons to improve their acquisition, classification, and identification of a broad range of targets will be initiated. Integration of multi-aperture optics and optical processing technologies to obtain sensors with larger fields of view and faster processing speeds will begin. This will allow higher speed and longer range missiles while eliminating costly components (such as gimbals and scanning mechanisms). Gallium arsenide 3-D ranging sensor technology for submunitions will be evaluated. Adding this accurate ranging capability to submunition sensors will increase target acquisition and optimize fuzing, thus increasing submunition effectiveness.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of an improved MMW seeker

and Application of the algorithms and technology advancements to obtain a lower cost, higher precision, all weather terminal guidance capability against mobile and fixed ground targets will be initiated. An advanced radome and receiver design will be developed to provide dual-mode, multi-band radio frequency operation. This will provide missiles with a greater anti-jam capability, and expand their radiation homing capability to a broader target set. A brassboard test and evaluation of lower cost, higher reliability radio frequency seeker components will be conducted. These components could result in savings of $10,000 to $20,000 per unit of missile guidance systems. Breadboard demonstration of seeker designs effective against projected Soviet future threats will be completed. This cooperative effort with the Navy will provide the technological edge to maintain air superiority in future conflicts. The project will develop and demonstrate a gallium arsenide 3-D ranging sensor. This effort provides a low cost option that gives submunitions increased target acquisition range and improved fuzing control. Breadboard designs for the multi-aperture seeker will be completed. The project will demonstrate a noncooperative, high resolution scoring system that scores missiles and gunnery systems against air targets.

(4) (U) Program to Completion: This is a continuing project. Autonomous all-weather seeker brassboards to defeat high value targets and ground mobile targets will be demonstrated in captive flight tests.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06AL, Air Force Armament Laboratory Operations.

A. (U) Project Description: This project funds the management and support of the AF Armament Laboratory, Eglin Air Force Base, FL. AFATL is responsible for exploratory and advanced development associated with conventional weapons. This project provides support for in-house programs. It covers salaries of civilian scientists, engineers and support personnel; travel; transportation, rent, communications and utilities costs; procurement of supplies and equipment; and contractor support services. This project supports and complements all projects within this program element.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable

10. (U) COOPERATIVE AGREEMENTS: Not applicable

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0602702F
DOD Mission Area: 521 - Electronics and Physical Sciences (ED)

Title: Command, Control, and Communications
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 77,695 | 75,640 | 85,181 | Continuing | N/A |
| 06RA | Laboratory Operations | 39,915 | 38,656 | 40,709 | Continuing | N/A |
| 2338 | Assurance Techniques for Electronics | 5,429 | 5,625 | 6,050 | Continuing | N/A |
| 4506 | Surveillance Technology | 8,515 | 8,205 | 9,480 | Continuing | N/A |
| 4519 | Communications Technology | 4,595 | 4,285 | 5,120 | Continuing | N/A |
| 4594 | Intelligence Technology | 5,861 | 5,210 | 6,530 | Continuing | N/A |
| 4600 | Electromagnetic Radiation, Devices and Components | 6,190 | 6,683 | 9,280 | Continuing | N/A |
| 5581 | Command & Control Technology | 7,190 | 6,976 | 8,012 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program advances Air Force mission capabilities in Command, Control, Communications and Intelligence ($C^3I$). Current operational requirements include: (1) increasing the operational availability of $C^3I$ systems through improved reliability and maintainability of electronic components and systems; (2) improving the effectiveness and survivability of $C^3I$ systems through reliable and secure communications; (3) improving surveillance range and detection capabilities against both low observable threats and enemy electronic countermeasures; and (4) improving the timeliness and quality of intelligence data for decision makers. Technical projects address six technology areas which advance the state-of-the-art in $C^3I$: (1) electronic reliability/maintainability and electromagnetic compatibility; (2) surveillance; (3) communications; (4) intelligence; (5) electromagnetic radiation, devices and components; and (6) information processing. The program element also provides for management and support of the Rome Air Development Center (RADC), Griffiss AFB, Rome, NY, with two divisions of RADC located at Hanscom AFB, MA.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 75,819 | 82,260 | 84,061 | Continuing | N/A |

EXPLANATION: (U) The 2.3 million increase in FY 1987 was because of salaries reimbursement. The decrease in FY 1988 was due to Congressional markups and Air Force adjustments in TOA in FY 1989.

PE: 0602702F

4. (U) **OTHER APPROPRIATION FUNDS: ($ in thousands):** Not Applicable.

5. (U) **RELATED ACTIVITIES:** This program is coordinated at Tri-Service and interagency levels to preclude duplication and to meet overall Department of Defense (DoD) needs in Command, Control, Communications and Intelligence related technologies. Examples of this coordination are the DoD Advisory Group on Electronic Devices, the Interservice Antenna Group, and the Radiation Hardened Electronics Technology Coordinating Group. DoD has fostered close coordination between the Services in several technology areas affecting this program, particularly in the surveillance and communications areas. Space Based Radar surveillance programs are closely planned with the Navy, and a joint technology coordination group was established in 1985. A Tri-Service Fiber Optic Coordinating Group chartered by the Office of the Under Secretary of Defense for Research and Engineering coordinates all fiber optics Science and Technology work (6.1, 6.2, and 6.3) and implements joint programs (funding, technical effort, and testing). Rome Air Development Center (RADC) chaired this group in 1986. Image exploitation programs are coordinated through a national committee, and the Defense Mapping Agency (DMA) coordinates all Service programs in mapping and charting. The National Security Agency coordinates all Service programs in signals intelligence and computer security. The Defense Intelligence Agency coordinates Service programs in intelligence data handling. The technologies developed in this PE transition to the following Program Elements for advanced development: PE 0603728F, Advanced Computer Technology; PE 0603789F, Command, Control and Communications Advanced Development; PE 0603726F, Fiber Optics Development; PE 0603260F, Intelligence Advanced Development; PE 0603701B, DMA Advanced Development; PE 0603738F, Air Defense Initiative Surveillance Technology; PE 0603743F, Electronic Combat; and PE 0603106F, Logistics Systems Technology.

6. (U) **WORK PERFORMED BY:** This program is managed by RADC, Griffiss AFB, NY. The top five contractors are: Westinghouse Corp., Baltimore MD (project 4506); Univ. of Southern CA, Los Angeles CA (project 5581); UNISYS, Saint Paul, MI (project 5581); Knowledge Concepts, Rome, NY (project 5581); and General Electric Co., Syracuse, NY (project 4506). There are 100 additional contractors and the total dollar amount of the additional contracts is $40 million.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:**

A. (U) Project: 2338, Assurance Techniques for Electronics. This project provides technology which increases reliability and maintainability (R&M) for electronic devices and systems while assuring electromagnetic compatibility. Payoffs include increased system availability and lower life cycle costs with systems having higher R&M. To improve electromagnetic compatibility, techniques to eliminate interference problems are necessary, particularly when smaller, densely packed radio frequency emitters are integrated in an aircraft. FY 1987 accomplishments included development of combined networks for conducting interference testing of advanced microcircuits (VHSIC). Off the shelf components were utilized and interfaced with standard test equipment and automatic test equipment with suitable software. Generic guidelines were developed to assess the susceptibility of C3 and weapon systems to high power microwave. Techniques were developed to assess the effects of Monolithic Microwave Integrated Circuits components to external

electromagnetic (EM) environment and assessed current analysis/modeling capabilities to predict undesired response to the unattended EM energy. A design study for implementation of reverberation chamber techniques for EM susceptability/vulnerability was completed. FY 1988 plans include increased emphasis on technologies that impact system reliability, fault tolerance, maintainability, cost, and performance. New efforts will develop computer aided engineering modules for designing in reliability at system and device levels. The application of artificial intelligence to built-in-test (BIT) technology will result in the development of computer modules for SMART BIT (i.e., BIT which can perform "intelligent" functions such as circuit reconfiguration to correct faults). Additional new starts will address the reliability and maintainability aspects of monolithic millimeter wave integrated circuit technology. Efforts will be completed in electromagnetic compatibility development for advanced modulation techniques.
In FY 1989, plans call for the continued emphasis on improved reliability, fault tolerance, and maintainability for next generation advanced technology devices and systems. The feasibility and simulation of a number of promising reliability, maintainability, and technology concepts will be demonstrated. Application of fail soft, fault tolerant concepts which will enable systems to operate despite failures and battle damage and which can gracefully degrade as failures accumulate, rather than fail catastrophically will be demonstrated on advanced Command, Control, Communication, and Intelligence ($C^3I$) system models.

B. (U) Project: 4506, Surveillance Technology. This project develops advanced ground, airborne, and space based system concepts and technologies required to accomplish future Air Force surveillance missions. Major development efforts include: technology for new surveillance radars; surveillance technology to counter low observable threats; and counter-countermeasure technologies to defeat electronic warfare threats directed against our surveillance systems. Enabling technologies for space based radar and an advanced airborne surveillance radar (future Airborne Warning and Control System) with capabilities to detect and track high speed, low radar cross section threats in severe jamming environments are based on the signal processing, array antenna techniques and solid state transmit/receive (TR) modules developed in this project. Multistatic radar technologies and advanced concepts to detect and track low observable threats are developed. Signal processing technology is developed employing advanced algorithms and architectures. Solid state TR modules using Monolithic Microwave Integrated Circuits are developed to improve performance and reliability and to reduce size, weight, and cost. Microwave tubes for satellite communication airborne terminals, satellites, ground and airborne radars are improved and developed. FY 1987 accomplishments included fabrication of an optimized 6 Bit C-Band phase shifter and 30% efficient 5 Watt C-Band power amplifier for a tactical phased array. TR Space Based Radar modules demonstrated have power amplifiers which produce 3.4 watts of Radio Frequency power at 30 decibel (DB) gain and 35% power added efficiency. Fabricated and tested the first 100 S-Band modules and delivered first prototype to conformal array contractors. Developed 15 watt Pulse Per Minute focused Continuous Wave tube using electron discharge machine circuit construction and an isolated and biased focus electrode for superior beam transmision. Demonstrated 94 Gigahertz gun/circuit Traveling Wave Tube using isolated and biased focus electrode system with 99% beam transmission. Validated the bistatic radar evaluation tool using actual bistatic radar data to evolve promising bistatic techniques using noncooperative reduction. An analog acousto optical adaptive process for cancelling continuously dispersed noise signals was tested, with cancellation rates of 30DB demonstrated. A programmable 320 Megahertz wideband system including hardware and supporting software has been completed, calibrated, and tested

inhouse. The system allows data to be taken at various bandwidths, providing signature data for input into an Identification fusion alogorithm. FY 1988 plans include efforts supporting Space Based Radar technology research where an experiment is planned for the evaluation of distributed sensor concepts. This will demonstrate the beam steering/performance capabilities and coherence of a distributed sensor system in a space-like environment. Electronic counter-countermeasure techniques will be developed to defeat future smart jammers using spatial or temporal rejection or exploiting jammer characteristics. Advanced beamforming integrated with transmit/receive (TR) modules under digital processor control will be developed for use on an airborne radar demonstration. Radar experiments and methods to effectively combine information from airborne sensors will be developed. To meet the surveillance requirements of low observable threats in a dense jamming/clutter environment, advanced signal processing techniques such as multi-domain (time, frequency, polarization, spatial, etc.) processing algorithms will be evaluated in conjunction with advanced information processing techniques including knowledge based tracking. In addition to these processing techniques, advanced TR module circuits will be developed to improve detection capabilities in a dense jammer/clutter environment. Efforts to integrate scanning arrays, sensors, monolithic circuits, and controls into external surfaces of aircraft and missiles will be initiated to support the initiative to integrate Command, Control, Communication and Intelligence ($C^3I$) functions into the skin of an aircraft (i.e., "Smart Skins"). In FY 1989 methods to detect threats with reduced radar cross sections (stealth) and to survive increased enemy electronic warfare capabilities will be developed to successfully accomplish future Air Force surveillance missions. Emphasis will be placed on the development of multi-spectral sensors to counter both the low observable as well as electronic warfare threat. The sensors will be developed for use with either ground based, airborne, or space based systems. The technology base requires the development of multiband passive and active sensors which can provide both long range target detection and sufficient target resolution to allow hand off/engagement to a weapon system. Integral to this process will be the development of methods of identification using individual sensor high resolution methods. Advanced high throughput processors using Very High Speed Integrated Circuit submicron and Gallium Arsenide devices will be developed.

C. (U) Project: 4519, Communications Technology. This project develops technologies which increase communication data rates, survivability and flexibility. Communication survivability technologies include enduring network techniques, advanced processors, spread spectrum modems, and adaptive nulling techniques. Improved satellite communication technologies for global communications are developed. Since future $C^3I$ systems will be more distributed for survivability, communication links between distributed elements will assume greater importance. Fiber optics technologies for high payoff applications in Air Force $C^3I$ systems are developed. Although fiber optics technology for land based voice and data communications have matured in the commercial sector, unique Air Force requirements make the fiber optics research and development in this project essential. Air Force applications include: replacement for radio frequency (RF) waveguides where volume and weight are tightly constrained; field ruggedized fiber optic based systems; and optical multiplexers and transceivers for high capacity, secure communication systems. FY 1987 accomplishments included development of a ruggedized splice kit for tactical optical fiber. The splice kit provides a 10:1 tc 20:1 reduction in cost cost and 50% reduction in time with half the amount of training required. Developed a wideband RF transmission system utilizing single mode optical fiber, which demonstrated a 22 Gigahertz modulation and transmission capability.

Established a technology base to design and fabricate high performance Acoustic Charge Transport on Gal'ium Arsenide, for application to wideband low probability of intercept communication. In FY 1988 the design of an all-optical, laser-based communication system array antenna operating between 20 and 60 Gigahertz will be completed. Work on optical computer-based processing will be initiated. In FY 1989 a multi-gigabit, single-mode fiber optic local area network will be demonstrated. The Integrated Communication System Simulator will be operational to determine the endurability of communication networks. Work will be initiated on a smart, self-adaptive receiver which will be highly resistant to the total spectrum of countermeasures.

D. (U) Project: 4594, Intelligence Technology. This project develops technologies which improve and automate Air Force capabilities to process and provide useful and timely intelligence information from all sources. Improved data recording and handling techniques are developed for timely processing, storage, and dissemination of extremely high data rate, large volume digital information. Near real-time target classification and multi-sensor correlation techniques are developed to increase the quality and timeliness of intelligence. Data base handling techniques and knowledge based systems are developed to improve the consistency, quality, and speed of intelligence analysis. Advanced cartographic and photogrammetric technologies are developed for extracting three dimensional earth surface data to support en route and terminal guidance of future Air Force weapon systems. FY 1987 accomplishments included development of a single channel Very Large Scale Integrated Speech Enhancement Unit to reduce cockpit noise generated by the microphone. Software was developed to manipulate threat laydown interaction with strike packaging using electronic combat assets. Concept studies were completed creating various 21st century concept for electromagnetic combat analysis aid based on projected threat and future Tactical Air Control Systems. Improved the synthesis algorithms that produce natural sounding speech for the programmable voice units. Developed methods to improve concentration of speech using Lincoln Labs sinusodial transformation process which smooths the boundary between concentrated segments of speech. Completed upgrade of narrowband algorithms for improved jam resistant communications providing a fixed rate of 400 bits per second in voice communication. A functional specification for an advanced network resident database to support access to heterogeneous databases in both long haul and local area network environments was developed. FY 1988 will continue development in automated imagery exploitation, target detection, classification, and identification, and the application of advanced technology to counter denial and deception tactics. New efforts include the development of techniques for exploiting airborne visual and infrared spectrometer data for countering denial and deception techniques, and advanced techniques for applying artificial intelligence to automated imagery exploitation. In speech processing, voice synthesis will be extended to include all North Atlantic Treaty Organization languages. Techniques will be developed to allow voice synthesis to support graphic displays used in a battle management information system. In FY 1989 the development of optical memory techniques, and natural language speech recognition techniques will continue. Efforts in knowledge based (expert systems) for intelligence analysis consisting of automated acquisition tools, and knowledge representation techniques for characterizing various threats will be initiated. In addition, a data base/knowledge base interface will be developed.

E. (U) Project: 4600, Electromagnetic Radiation, Devices and, Components. This project provides a strong

tecnology base in solid state devices and techniques required to utilize millimeter wave, microwave, and infrared (IR) radiation in Command, Control, Communications, and Intelligence ($C^3I$) systems. Technologies developed include monolithic microwave integrated circuits and phased array antennas to provide more affordable, higher performance radars and communications systems. Electromagnetic propagation and scattering technology developed can determine efficient propagation techniques for communication and surveillance systems using propagation modeling and provide detailed characterization of low observable targets. Components such as short cavity lasers, quantum-well lasers, low loss fibers, and modulators that operate at very high modulation rates are developed for future military fiber optic systems. High purity materials with tailored properties, such as quartz, indium phosphide (InP) and its alloys, and fluoride glasses are developed. Air Force systems require technologies for precision time and frequency devices which depend on the materials developed in this project. Signal processing and sensing devices developed in this project will lead to more capable passive battlefield sensors and space object detection systems with reduced cost of ownership. Research in radiation hardening of devices and components will ensure $C^3I$ mission success in nuclear and space environments. FY 1987 accomplishments included design and fabrication of 64 element Butler transform feed for a lens array and adaptive control network for antenna pattern nulling with applicability to Space Based Radar program. Developed 32 element digital beamforming array, which included self-surveying network to elements dispension and circuit tolerance effects, application to both air and ground based surveillance and communication systems. Formulated comprehensive bistatic clutter model formulated for rough surface scattering for arbitrary antenna locations developed a high-precision ray tracing computer code to the problem of realistically simulating ducted ray propagation. A single frequency high latitude meteor link was established in Alaska, in the Auroral Oval Region, to provide data on the effects of Auroral scatter and sporaric E propagator. Established baseline sensor theory to include the collective influence of point to point non-uniformities in the detector array. Demonstrated silicide IR camera capability and applicability to various Air Force and DOD missions. Developed wideband microwave optical transmitter which operates at a wavelength of 1.3 microns and can be directly modulated at frequencies beyond 20 Gigahertz (GHZ). A new concept for a secure fiber optic system for the transmission of video signals, based on the frequency modulation threshold effect, has been verified. Developed a phase-only filter which is required for low power optical correlators to maximize detector output signal-to-noise ratio. This high optical efficiency reference filter, which will be part of a hybrid optical/electronic pattern recognition system will be useful for target acquisition and tracking, correlator guidance, machine vision and all pattern recognition. The FY 1988 planned program will emphasize optical control of phased arrays and techniques for using optical components for the generation of microwave and millimeter wave energy. Another area of emphasis will be the reduction of the radar cross section of antennas through the use of radomes. A Platinum Silicide IR acquisition camera will be completed and installed at the Air Force Maui Optical Station for assessment as a satellite tracking device. Programs in photonics will develop high resolution spatial light modulators, high frequency modulation of semiconductor lasers and integrated optical/electronic millimeter wave-microwave devices. Improved methods for fabricating dielectrically isolated substrates for radiation hardened electronics will be developed using ion implantation and recrystallization techniques. InP substrates will be demonstrated for thermal stability. Conformal array technology will be developed to support the integration of $C^3I$ capabilities into the aircraft skin. In FY 1989 a full scale array program will be initiated to develop operating arrays at 20 and 44

Gigahertz (GHz) for airborne satellite communication terminals. Initial subarray developments at 60 GHz will be completed. Transition to 6.3 of a low cross section antenna will be made. A two-dimensional high frequency adaptive beam forming array will be evaluated for antijam and clutter mitigation. A long wavelength silicide infrared camera will be developed and tested for tactical and strategic sensors. The materials and devices program will include investigtion of quantum-well structures for enhanced electrooptic and nonlinear optical components which will provide a higher efficiency rating.

F. (U) Project: 5581, Command and Control Technology. This project develops technologies which advance Air Force capabilities in Command, Control, Communications and Intelligence ($C^3I$) by providing strategic and tactical field commanders with improved techniques for the processing and presentation of information for battle management. Technical areas include: Artificial Intelligence (AI) including expert system Command and Control ($C^2$) decision aids; distributed processing techniques for the implementation of distributed, rather than centralized, $C^2$ systems for increased survivability; and, finally, technologies and $C^2$ processes for implementing electronic combat in battle management. $C^3I$ software systems have become very costly due to large size and a high degree of complexity. To reduce software costs and to increase the quality and reliability of software, software engineering research in this project addresses: research on software tools (such as editors, compilers, etc.) for more efficient software development; rapid prototyping of software systems so a user can better specify what he wants before all the software development is done in detail; and procedures for measuring how well software will perform and how easily it can be supported. The AI technology developed in this project supports both the software effort and $C^2$ decision aids. FY 1987 accomplishments include design specification completion for C3I computer based support environment of integrated software engineering tools and methods applicable during the development and post deployment of critical system software. Designed advanced testing applicable to programs written in Ada in accordance with Mil Std 1815A. Exploratory development software provided as basis for Tactical Air Command to assist wing/squadron planner with selection of low lethality routes for mission planning. Designed heterogenous database systems composed of different types of hardware and software elements applicable to strategic and tactical battle management systems. A prototype project management assistant was developed which currently demonstrates support for project monitoring and communications. Developed and demonstrated advanced artificial intelligence technology supporting rapid replanning in resource allocation planning tasks. In FY 1988 the Knowledge Based Software Assistant support for distributed operating system allocation procedures will be investigated and developed for advanced $C^2$ systems. Emphasis in the area of survivable Command, Control, and Communications will be developing distributed system reconstitution techniques using network and distributed data base reconfiguration strategies. Efforts will continue to explore the applicability of state-of-the-art optical processing devices in hybrid (optical/electronic) computers and to investigate the design of optical digital computers. Knowledge based systems technology will be developed. Technology efforts contributing to the Battle Management Information Processing and Display System thrust will also be developed. Work will be initiated for reusable specification to reduce up front costs in software development. The results will be applied to requirements analysis during the concept definition phase of the software life cycle. During FY 1989 emphasis in the distributed systems area will be on the

development and demonstration of control strategies which support reconfigurability and real-time distributed processing. Software engineering technology for significantly improved software evaluation will be provided by developing a software measurement testbed capability. The results of prior logic programming efforts will be incorporated into a design for a rapid prototyping system based on this technology. Efforts will be completed for combining knowledge based and conventional software engineering tools.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06RA, Laboratory Operations

A. (U) Project Description: This project provides management and support for Rome Air Development Center (RADC), Griffiss AFB, NY, and two divisions of RADC located at Hanscom AFB, MA. Support provided includes pay and related costs of civilian scientists, engineers, and support personnel; travel; transportation; rents; communications; utility costs; procurement of supplies and equipment; and contractor support services. In addition to the research and development program described above, RADC manages technology intensive engineering development programs, primarily in the intelligence area and provides technical support to system program offices.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603106F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Logistics Systems Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 11,477 | 9,574 | 16,436 | Continuing | N/A |
| 2745 | Logistics for Combat Readiness Maintenance | 655 | 75 | 4,075 | Continuing | N/A |
| 2940 | Computer Technology for Systems Design and Maintenance | 7,879 | 6,444 | 7,326 | Continuing | N/A |
| 2950 | Integrated Maintenance Information System | 2,943 | 3,055 | 5,035 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program is the major technology development effort supporting the Department of Defense (DOD) Computer-Aided Acquisition and Logistics Support initiative. The Air Force must improve the reliability, maintainability and combat supportability of both current and future weapon systems. The on-going explosion of computer and data automation technologies offer, for the first time, the ability to address these problems throughout the lifetime of a weapon system while giving relief from the current dependency on inefficient and voluminous paper-based technical data systems in use throughout the DOD. However, this transition from paper to automated, electronic data must be done systematically, be more useful than the paper it replaces, and be cost effective for both the DOD and the supporting private sector. The Logistics Systems Technology program will develop, validate and demonstrate the technologies necessary for this transition to occur and produce the specifications and standards required to insure a DOD/industry wide automated data management philosophy which is compatible with all users. Technologies currently under development will: (a) allow individual maintenance technicians to do many different jobs with the help of portable electronic job aids; (b) enable weapon system designers to see maintenance implications as they create system designs on a computer-aided-design terminal; (c) make essential engineering and maintenance data instantly available throughout the lifetime of the system; (d) allow rapid determination of the best balance of conflicting performance, manufacturing and performance requirements for more reliable and supportable weapons and (e) give the ability to integrate accurate wartime logistics data into computer based logistics planning and combat capability assessment models.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 10,740 | 12,747 | 19,645 | Continuing | N/A |

EXPLANATION: (U) FY 1988 differences are due to Congressional reduction. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority, and will require a major descoping of the validation and demonstration efforts in Project 2940.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Continuing and close coordination among the Army, Navy, Air Force, other Department of Defense (DOD), National Aeronautics and Space Administration (NASA) and industrial organizations is done to eliminate redundancy in logistics research and development. Projects are coordinated with: NASA's Integrated Program for Aerospace Design and with DOD Manufacturing Technology Advisory Group through membership on their Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) subcommittee; the Joint Logistics Commanders' Joint Policy Coordinating Group for Logistics Research, Development, Test & Evaluation subpanels for Automated Technical Information, and Reliability, Availability, Maintainability in Computer Aided Design (RAMCAD); and The National Security Industrial Association, Logistics Management Committee, CAD Working Group. CAD efforts are also coordinated with the Integrated Computer Aided Manufacturing Program of PE 0708011F. Technologies which support the DOD Computer-Aided Acquisition and Logistics Support (CALS) initiative are closely coordinated with all aspects of the CALS effort, including PE 0603736D Computer Aided Logistics Support. Technology input to PE 0603106F comes from related program elements: 0602201F, Aerospace Flight Dynamics; 0602202F, Human Systems Technology; 0602205F, Training and Simulation Technology; 0602702F, Command, Control, and Communications; 0603253F, Advanced Integration Avionics; and 0603751F, Training Systems Technology. Technology outputs are provided to 0604740F, Computer Resource Management Technology; 0708011F, Manufacturing Technology; 0603742A, Advanced Electronic Devices; 0603712N, Generic Logistics R&D, and others.

6. (U) WORK PERFORMED BY: This program element is managed by the Air Force Human Resources Laboratory, Brooks AFB TX, through their Logistics and Human Factors Division, Wright-Patterson AFB OH, with direct support from the Air Force's Flight Dynamics Laboratory, Wright-Patterson AFB OH. Many development tasks require multi-laboratory efforts with specific laboratory involvements varying from one year to the next. Primary contractors doing work funded by PE 0603106F include: Rockwell International, Los Angeles CA (2940); TRW Inc., Fairfax VA (2940); Boeing Computer Services, Seattle, WA (2940); Systems Research Labs., Beavercreek, OH (2940,2950); and General Dynamics Corporation, San Diego, CA (2940,2950). There are eight additional contractors doing work with a combined dollar value of $4 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2745, Logistics for Combat Readiness Maintenance. The Air Force needs to accurately predict how many people and parts must be provided when tactical aircraft are deployed in combat. Currently no satisfactory analytical tools or procedures exist to determine the changes in demand for aircraft maintenance from peacetime to wartime. Aircraft battle damage and intense operational use of weapons delivery systems and electronic warfare systems create wartime demands for spare parts, maintenance skills and levels of repair activity which are not seen in peacetime. Studies of wartime data from recent conflicts show that extrapolation from peacetime experience does not give realistic results. This project develops data bases, derived from actual combat experience, and analytical methods that will allow the accurate determination of resources needed under wartime conditions. Factors that drive maintenance in combat will also be identified through analysis of actual wartime data. FY 1987 Accomplishments. Recommendations were developed for realignment and restructuring of maintenance career fields. This realignment, made possible by the new maintenance aids being developed under Project 2950, Integrated Maintenance Information System, will permit fewer,

less-specialized technicians to support dispersed, high surge operations in combat. FY 1988 Program. The transition of combat data bases and analysis software to the Department of Defense (DOD) Survivability Vulnerability Information Analysis Center will be completed. FY 1989 Planned Program. Planning will begin for a field test integrating new combat maintenance capabilities with the previously realigned maintenance career fields. Techniques and methods will be demonstrated for performing maintenance in a chemical/biological warfare environment. A joint effort will be initiated with the Navy's Rapid Acquisition of Manufactured Parts (RAMP) program (PE 0603712N) to demonstrate and validate the technology and techniques developed by this program element. A major portion of the growing parts unavailability problem faced by the DOD can be traced to the diminishing manufacturing sources for spare parts support. The ability to accurately predict parts requirements, being developed under this project, and the capability to handle automated engineering data being developed in Project 2940, Computer Technology for Systems Design and Maintenance, will form a critical data base to support the rapid parts-manufacturing demonstration facility being constructed at the Charleston, S.C. airport by the RAMP program.

B. (U) Project: 2940, Computer Technology for Systems Design and Maintenance. Reliability, maintainability, and testability are characteristics which must be designed into Air Force systems. Our goal is to specify, develop, validate and demonstrate computer technology necessary to improve weapon system design and supportability. The project consists of three parallel, interrelated tasks: (1) Reliability, Availability, Maintainability in Computer Aided Design (RAMCAD), the application of decision aids and expert systems to design for supportability; (2) Integrated Design/Support System (IDS), electronic access of all weapon systems engineering data throughout the life time of the weapon; and (3) Unified Data Base (UDB), an automated, interactive data base for logistics support analysis data. These tasks will result in the specifications and standards needed for consistent, rapid electronic interchange of technical information within the DOD and industry. The first task, RAMCAD, will develop computer-aided design methods to enable contractors to more effectively incorporate reliability, maintainability and testability into weapon systems designs. This will reduce expensive and time-consuming redesigns and modifications, and will produce far more supportable and operationally ready weapon systems. This task will also develop decision aids, in support of the Air Force's Unified Life Cycle Engineering (ULCE) initiative, which will allow designers and logisticians to evaluate tradeoffs between performance and maintainability, and allocate requirements in a consistent manner throughout the total design and acquisition process. ULCE will include user-friendly decision aids necessary to integrate performance, supportability, and producibility factors when choosing among system design alternatives. The second task, IDS, will provide specifications, standards, and software to allow the Air Force to electronically access contractors' weapon system technical information data bases, and to facilitate exchange of technical information between prime contractors, subcontractors and the Air Force. Industry has moved rapidly into computer-aided design systems, yet the Air Force cannot communicate directly with these data systems to review and evaluate weapon system designs. Neither can the Air Force currently save this valuable data, except on paper or microfilm, for subsequent logistics, maintenance, remanufacturing or engineering needs. This project defines the specific engineering data base required by the Air Force and develops the software and data management architectures required for interactive communication of digitized engineering data. The third task, UDB, will for the first time allow the replacement of the current, paper-based, manual system for logistics support analysis data with automated, electronic data-processing capability. The UDB technology will provide current logistics planning data and accurate field operational experience on weapon system

performance to both the government and contractor engineers. FY 1987 Accomplishments. New Reliability, Availability, Maintainability in Computer Aided Design (RAMCAD) techniques were developed and tested through their application to F-15E support equipment and procedures for munitions loading within the cramped space constraints of a hardened aircraft shelter. A major contract was awarded for integrating various electronic reliability design techniques into a single model, to be accessed through a computer aided electronic design workstation. The Integrated Design/Support (IDS) program began a major technical advance to integrate data bases on multiple types of computers using B-1B aircraft structural component data as a test case. The Unified Data Base completed validation, verification, and documentation, and entered certification for Department of Defense (DOD) wide use. FY 1988 Program. RAMCAD will be expanded to include a computerized person (anthropometric) model incorporating size, strength, and mobility of Air Force maintenance technicians. Use of this model, developed jointly under Program Elements 0602205F, Training and Simulation Technology, and 0602202F, Human Systems Technology, will provide visual simulation of maintenance and component access problems directly to system designers on their Computer Aided Design terminals. Draft specifications and processes for incorporating RAMCAD into contract requirements and using it to conduct design reviews will also be developed based on a test application with the Integrated Electronic Warfare System (INEWS). The IDS System task will continue design and development efforts in preparation for future demonstrations and testing. FY 1989 Planned Program. The human modeling for maintainability will be expanded to include dynamic simulation of maintenance time, and full integration into the design tradeoff process. An integrated design workstation for electronic and mechanical components, jointly funded with the Army, will be developed. These enhancements will allow engineers to design systems right, for maintainability, the first time. The RAMCAD project will begin to provide the nucleus technology for the long-term multi-laboratory work in integrating design, logistics, support, and producibility disciplines into the computer-aided design Unified Life Cycle Engineering concept. IDS will initiate a test of the information modeling methodology in an Air Logistics Center, to demonstrate the capability for sharing the same engineering data through a common data management system. Work will also be undertaken to develop new automated techniques so that the underlying analysis can be accomplished faster and at lower cost. In FY 1990, testing, verification, and validation of prototype RAMCAD software will be the basis for specification and standards development for use Air Force wide.

C. (U) Project: 2950, Integrated Maintenance Information System (IMIS). IMIS will develop for the flight line maintenance technician automated maintenance instructions and a fault diagnostic capability through a single, portable computer display. The user-friendly, stand-alone IMIS portable computer device will allow maintenance technicians to work interactively with built-in test capabilities of the weapon system. IMIS's rapid automatic supply status interrogation and reporting will allow managers to quickly pinpoint deficiencies in supply or maintenance procedures or training. When fully developed for field use, the IMIS terminal and software will permit fewer people to perform a wider range of maintenance tasks in the deployed tactical environment of the future. FY 1987 Accomplishments. A relational authoring approach was developed and tested. It creates electronic technical orders in the form of relational data bases which require less computer storage space than fixed pages and which allow screen displays to be tailored to the skill of the individual technician. Extensive diagnostic analysis and generic diagnostic system design was accomplished for mechanical, hydraulic and electronic subsystems using flight data from advanced designs such as the X-29 experimental fighter. The IMIS technician data display concepts were independently verified by the Navy in testing at Naval and Marine Air Stations, and now form the basis for developing common specifications for all three Services.

FY 1988 Program. Software development will begin for the Integrated Maintenance Information System (IMIS) portable maintenance aid to be field tested in FY 1989 with the interactive diagnostics on an F-16 electronic subsystem. This will lead to a joint test with the Navy on an F/A-18 subsystem in FY 1990. FY 1989 Planned Program. The requested funding is necessary to translate the weapon system data from paper technical orders into digital form for these crucial proof-of-concept field tests. The initial development contract will be awarded for an advanced IMIS that will include a supply and reporting interface, simulation capability for training in the field, and full system integration of diagnostics for Very High Speed Integrated Circuits and modular electronics architectures. This increased diagnostics capability will permit the maintenance technician to readily assess the condition of modern, modular, fault tolerant, reprogrammable, redundant electronic circuitry. Thus, the technician will be able to determine whether a partially degraded system can continue to support combat missions without downtime for repairs. Development and evaluation of technologies, such as display screens with low power requirements and voice recognition, applicable to rugged, portable, computerized maintenance aids will continue. Initial IMIS results will be available in FY 1990 for use by the Advanced Tactical Fighter (ATF) and Joint STARS programs. Field demonstrations of the hardware, software, system architecture, and equipment interfaces will culminate with transition into the Very High Speed Integrated Circuit and advanced modular architecture insertion programs in the early 1990s, and will become the standard for the Air Force Automated Technical Order System.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The Israeli Air Force has agreed to provide classified combat logistics data on several aircraft to the US Air Force Human Resources Laboratory for use in the development of a combat data base and analysis system. This work will be completed in FY 1988.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603109F — Title: INEWS/ICNIA

DOD Mission Area: 551 - Electronic and Physical Sciences(ATD) — Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 102,453 | 85,300 | 37,423 | Continuing | N/A |
| 2273 | Integrated Electronic Warfare System (INEWS) | 32,118 | 31,946 | 11,121 | N/A | N/A |
| 2538 | Integrated Communication-Navigation-Identification Avionics (ICNIA) | 28,186 | 15,300 | 12,565 | Continuing | N/A |
| 2734 | VHSIC-Based Subsystems | 30,652 | 21,900 | 6,500 | N/A | N/A |
| 3003 | INEWS/ICNIA Modular Avionics System Architecture | 2,904 | 3,000 | 937 | Continuing | N/A |
| 3062 | Pave Sprinter | 5,193 | 10,654 | 2,800 | Continuing | N/A |
| 3393 | ICNIA Pre-FSD | 3,400 | 2,500 | 3,500 | 0 | 18,600 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Current avionics systems are major contributors to inadequate weapon system reliability and represent a substantial and increasing fraction of aircraft acquisition and support costs. The INEWS/ICNIA program will exploit a number of recent innovations in systems architecture, semi-conductor technology, computerization and computer software to integrate and automate avionics functions for current and advanced aircraft. This program will concentrate on the defensive electronic warfare and communications, navigation, identification avionics systems and the architecture technologies necessary to tie them together. Objectives include operational performance improvements, very high mission reliability, fault tolerance, substantial reductions in both acquisition and support costs and reduction of crew workload in dense threat environments. To satisfy these objectives major thrusts are currently underway for early insertion of Very High Speed Integrated Circuits processors in both core avionics and selected subsystems. Additionally, an intense effort will be pursued to develop standard modular packaging techniques and to flight test developed hardware on tactical aircraft. These efforts will greatly reduce size and weight, increase reliability and substantially lower overall operation and support costs.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 103,227 | 83,300 | 40,958 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 increase was provided by Congress in the Appropriations Bill for Advanced Tactical Fighter (ATF) related development. A subsequent Air Force reprogramming request for $30 million was approved in the House but two consecutive sources denied by the Senate. The Omnibus Continuing Resolution approved the reprogramming and increased the FY 1968 funding by $2.0 million.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 0602204F, Project 2003, Avionics System Design Technology, Project 6095, Inertial Reference and Guidance, Project 7662, Avionics Data Transmission and Reception and PE 0603203F, Project 2733, Advanced Reconnaissance Strike Radar will provide supporting technology for this program. PE 0603226F, DOD Common Programming Language (Ada) Advanced Development and PE 0603728F, Advanced Computer Technology will provide Ada support software products for use by this program for application to avionics related software developments. Close coordination with the Defense Advanced Research Projects Agency (DARPA) sponsored Pilot's Associate Program is needed so that expert systems technology can be used to reduce crew workload. Technical interchange between this program and PE 0603601F, Project 670A, Ordnance Technology, will be maintained to insure successful implementation of MIL-STD-1760 Aircraft-to-Stores Interface. Detailed dialogue with PE 0603231F, Project 2829, Cockpit Automation Technology will be maintained to insure appropriate use of new automation, control, and display concepts. The Advanced Tactical Fighter under PE 0603230F will be a prime user of these new technologies. Integrated EW/CNI, PE 0604250, will be the pre-FSD transition bridge into ATF/ATA.

6. (U) WORK PERFORMED BY: Current efforts are being performed by Rockwell International, Collins Avionics Division, Cedar Rapids, IA (ICNIA); TRW, Incorporated, San Diego, CA (ICNIA), and INEWS; International Business Machines, Manassas, VA (CSP); Sanders Associates, Nashua, NH (INEWS); General Electric Co, Utica, NY (INEWS); and Westinghouse Electric Corporation, Baltimore, MD (VHSIC 1750A and INEWS). The in-house organization responsible for the program is the Aeronautical Systems Division, Wright-Patterson Air Force Base, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2734, VHSIC-Based Subsystems: This effort develops advanced fault tolerant avionics system architecture concepts required to integrate and demonstrate key avionic technologies for future strategic and tactical

aircraft. Project makes major advances in such diverse areas as common modules, modular integration, optimal on/off equipment maintenance implementation, information fusion, integrated software concepts, artificial intelligence and expert systems. Emphasis is placed on development and validation of high risk technology into a cohesive integrated avionics system supporting significant improvements in availability, cost of ownership, and mission effectiveness for future weapons systems. In FY 1987 the program continued development of those elements required to support the design of a fault tolerant architecture. Emphasis is on serial high speed data bus, Very High Speed Integrated Circuits (VHSIC) 1750A data and common signal processors and the integration of avionics hardware subsystems as is being done with communications, navigation and identification subsystems. In FY 1988 the program will continue development of fault tolerant serial high speed data bus, VHSIC 1750A data and common signal processors, cockpit display devices, and advanced algorithm development. Development of a VHSIC 32-bit central processing unit (CPU) module will be initiated. The FY 1989 Planned Program will complete the common signal processor and VHSIC 1750A data processors and deliver for testing. After testing the common signal processor will be incorporated into the Ultra Reliable Radar being developed in PE 0603203F, Advanced Avionics for Aerospace Vehicles. The FY 1990 and beyond program will conclude the Very High Speed Integrated Circuit (VHSIC) 1750A data processors testing and the advanced development models will delivered to other programs for incorporation into new systems under development. The VHSIC 32-bit CPU module development will be completed and transition into the Advanced Tactical Fighter (ATF).

B. (U) Project: 3003, INEWS/ICNIA Modular Avionics System Architecture (MASA). The independent design and development of avionics subsystems on modern aircraft has resulted in a proliferation of hardware subsystems. These subsystems can be difficult to maintain, require unique and complex test equipment, require a huge number of different spares, and cannot share resources, resulting in single point failures. As we carry out the will of the Congress in merging these two programs into a concerted integrated avionics development effort, this project forms the cornerstone of our plan to design, develop, and implement standard line replaceable avionics modules and supporting integrated diagnostics, initially for the Integrated Electronic Warfare System/Integrated Communications, Navigation Identification Avionics (INEWS/ICNIA) system, and eventually all avionics systems, which will be compatible with the architecture specified by the Advanced System Avionics definition contracts conducted in project 2734, PE 0603253F. In addition to functional performance, the following evaluation criteria will be utilized for proof of concept: reliability, environmental performance, cost effectiveness, testability, adaptability to optimal on/off equipment maintenance, and module commonality. The effort will design and develop candidate avionics modules not developed under other projects, and integrated enclosures for these modules, addressing the problems of interconnections, rack mounting, power and cooling requirements. The FY 1987 program continued development of candidate avionic modules and the required enclosure, interconnections, rack mounting, power and cooling requirements. Continue development of advanced integrated diagnostic and fault tolerant techniques. Complete preliminary performance assessment of these techniques using modular VHSIC data and signal processors as test articles. Continue development of the VHSIC data and signal processors and high speed fiber optic bus. The FY 1988 program will continue the appli-

cation of these modular concepts to the integrated communications, navigation, identification system and to the fault tolerant integrated inertial reference system. Modular avionics standards for application across the spectrum of avionics systems will be developed. The FY 1989 program completes the initial standards development. The FY 1990 and beyond program designs and fabricates the initial set of standard line replaceable modules for insertion into new system developments. Funding requirements are based upon the cost of contracts for similar technology efforts and are category II.

C. (U) Project: 3062, Pave Sprinter: This project will flight demonstrate Integrated Communications, Navigation, Identification Avionics (ICNIA) developed in other projects within this program element. The primary emphasis of the project is to show the benefits of VHSIC technology for upgrades of these aircraft. The modular concepts will be first demonstrated in the five-function ICNIA terminal. In addition to proving the Very High Speed Integrated Circuits (VHSIC)-based modular architecture Pave Sprinter will demonstrate optimal on-equipment maintenance capability with the intent of reducing the dependence upon expensive intermediate maintenance support equipment. The FY 1987 program continued development of the Pave Sprinter ICNIA terminal and prepare for the flight test of the ICNIA on an F-16. The FY 1988 program will continue planning for integration of ICNIA into the flight test fighter aircraft and detailed test planning. The planned FY 1989 program will begin aircraft modifications to integrate the ICNIA for flight testing. Initial flight tests to prove concepts of resource shareing and fault tolerance through dynamic reconfiguration in flight upon failure will begin. As the Advanced Tactical Fighter (ATF) design evolves, the ATF avionics architecture will be evaluated and critical subsystems tested in the Pave Sprinter flight test series. Test results will be analyzed and the results fed back into the ATF design process. In the FY 1990 and beyond program flight testing critical subsystems under development will continue throughout the ATF prototype phase and key avionics technologies which can only be tested in flight will be tested in this project as a suplement to, and in conjunction with, the ATF ground-based avionics simulator.

D. (U) Project: 3393, ICNIA Pre-FSD. This project, which began in FY 1986, is designed to transition the advanced technology integrated avionics being developed in Project 2538, ICNIA, into full scale development (FSD) for the ATF and other aircraft. In FY 1987 the project initiated investigations of the signal mix needs of various current and future aircraft to determine the subsets of ICNIA capabilities to be included in FSD versions tailored for each type aircraft from the overall set of hardware line replaceable modules resulting from the ATF FSD effort. The planned FY 1988 effort completes the specification and initiates statement of work (SOW) preparation so that requests for proposals may be awarded. The planned FY 1989 effort, which completes the pre-full scale development (FSD) work, will analyze the results of the ATF ICNIA development initiation and prepare specifications and SOWs for development of ICNIA versions for other aircraft from the ATF-developed hardware and software modules to insure interoperability and commonality across many aircraft types of all three services. Funding estimates are based on the costs of similar efforts and are Category II.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2273, Integrated Electronic Warfare System (INEWS)

A. (U) Project Description: INEWS is an Air Force led, joint AF/Navy program to develop the next generation airborne self-protection warning and countermeasures system for advanced technology aircraft, to include the Air Force Advanced Tactical Fighter the Navy Advanced Tactical Aircraft and the Army LHX helicopter. INEWS is the defensive system, inseparable from the host weapon system, which will enable host aircraft to perform combat missions while operating in the technologically advanced multi-static/spectral, netted threat environment of the 1990s. This threat consists of airborne and surface based radar, electro-optical, infrared, and laser directed defense systems and the tactical command, control, communications network which links them together. The advanced threat complicates the INEWS requirement to provide aircrews timely and accurate threat warning with automatic application of optimum countermeasures. The INEWS response will be tailored to the specific mission requirement and threat environment in, at least, near real-time. Effective implementation of INEWS necessitates a defensive capability fully integrated with other aircraft sensors and avionics through an integrated avionics architecture (project 2734) to achieve total weapon system synergism.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: INEWS Phase IB, Demonstration/Validation preliminary FSD, continues in FY 1987 to insure that the INEWS program executes on schedule so that an effective, affordable self-protection capability is developed in concert with the development of the Advanced Tactical Fighter, Advanced Tactical Aircraft and other advanced technology aircraft. Specific tasks for FY 1987 include demonstrations of individual high risk elements through developing and refining laboratory hardware, identification of performance, integration packaging and installation risks, and projection of installed equipment performance. Reliability/maintainability/ producability/ effor through computer aided design/computer assisted manufacturing technology application was initiated. Concept definition, refinement, and concept tradeoff analysis was continued. Program costing for these risk reduction and system design refinement tasks was reviewed in September 1984.

(2) (U) FY 1988 Program: In FY 1988 the planned program continues preliminary FSD to demonstrate critical subsystem technologies, and validates each of the two competing concepts, specifically: software engineering environment demonstrations on each contractor's Integrated System Facility to validate the Ada software algorithms, sensor fusion demos and flight test of key sensors and expendables will occur.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program finishes DEM/VAL and will transition into the Integrated EW/CNI program, PE 0604250F. Actual FSD and sustaining engineering to meet specifications and platform requirements will be accomplished within the aircraft FSD programs.

(4) (U) Program to Completion: Not Applicable.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) Concept Definition Phase Begun | July 1984 |
| (2) DEM/VAL Phase Contract Award | June 1986 |
| (3) System Design Reviews | April 1988 |
| (4) Initiate DEM/VAL extension (PE 64250) | June 1988 |

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2538, Integrated Communications N· gation Identification Avionics (ICNIA).

A. (U) Project Description: Joint Air Force/Navy/Army project to design, fabricate and test technological approaches to an integrated radio frequency subsystem for aircraft. The technology being developed draws upon the VHSIC technology, applied to RF and digital systems. Payoff will be in reduced size, weight, and software changes. Technological feasibility will be established by early FY 1988. This project will proceed with integration of the Very High Speed Integrated Circuit (VHSIC) 1750A common data processor, and, if feasible in the latter stages with the functional integration of the common signal processor. Flight testing will be completed in FY 1990 for the ICNIA advanced development model. In conjunction with the National Security Agency develop an integrated Communications Security/Transmission Security (COMSEC/TRANSEC) module and integrate it into the Integrated Communications, Navigation, Identification Avionics (ICNIA).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Software coding continued, brassboard testing commenced. Funds from Project 3003 and PE 63452F, Very High Speed Integrated Circuits initiated integration and test planning for the Pave Sprinter (five function Air Force) terminal.

(2) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program includes final fabrication and testing of the various ICNIA terminals. Terminal deliveries will start in October 1988. An ICNIA terminal will be integrated into the IESS and development of advanced high anti-jam voice and data communications waveforms and their associated ICNIA radio function software modules will begin. Translation of the ICNIA software modules into the Ada language will commence. Funding requirements are based upon the cost of contracts for similar technology efforts and are category II.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Testing of the ICNIA terminals in the IESS will continue, and research into new high anti-jam voice radio waveforms will continue at a higher pace. The

translation of the ICNIA software modules into the Ada language will continue. Funding estimates are based on planning estimates and are Category IV.

(4) (U) Program to Completion: Translation of the Integrated Communications, Navigation, Identification Avionics (ICNIA) software modules into Ada will begin. The terminals will be tested in the Integrated Electromagnetic Spectrum Simulator and in representitive test bed aircraft. Development and testing of advanced anti-jam voice radio waveforms will continue, using ICNIA hardware and new Ada radio function software modules to stay ahead of the evolving Soviet Radio Electromagnetic Combat threat.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) Advanced Development Contract Awards | October 1983 |
| (2) Critical Design Review (CDR) | June 1985 |
| (3) Software CDR | March 1986 |
| (4) First Advanced Development Model (ADM) Terminal Delivery | October 1988 |

10. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603202F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aircraft Propulsion Subsystem Integration (APSI)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 25,210 | 20,000 | 21,099 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program provides for the design, development, test and assessment of advanced air breathing propulsion system technologies applicable to a broad range of subsonic, transonic/supersonic, and high Mach aircraft. It builds upon the core technologies developed under the Advanced Turbine Engine Gas Generator program. The sequential process from component development through generic engine testing is essential to demonstrate availability of new technologies. The scope of the program includes work on: (1) advanced inlet, fan, power turbine, engine control and nozzle components; (2) integrated testing of these components with advanced gas generators (i.e., Joint Technology Demonstrator Engine); (3) Expendable Turbine Engine Concept demonstrators for missile applications; (4) definition of engine inlet/exhaust system installation design criteria and propulsion integration technologies; (5) engine structural design criteria through hardware fabrication and test; and (6) improved engine survivability characteristics. These efforts must be performed to permit low-risk transition of advanced technology to engineering development and provide a needed basis for further advances in relevant component technology and integration techniques. This program will provide aircraft systems with a potential for longer range, higher cruise speed with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost and improved survivability resulting in increased mission effectiveness. Technology advances anticipated under this program can result in 35% to 60% reductions in aircraft takeoff gross weight and a 25 to 40% reduction in life cycle cost compared with current state-of-the-art engines.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 26,137 | 23,646 | 27,825 | Continuing | N/A |

EXPLANATION: (U) FY 1989 funding reflects Air Force budget reductions. FY 1987 and FY 1988 funding was reduced by Congressional action and Air Force undistributed reductions.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The exploratory development base for this program is provided by Aerospace Propulsion, PE 0602203F and Navy PE 0602122N, Materials PE 0602102F, and Aerospace Flight Dynamics PE 0602201F. Close technical coordination is maintained with the Flight Dynamics Laboratory, Aerospace Structural Materials Program, PE 0603211F, and with the Materials Laboratory. This program is closely related to the Advanced Turbine Engine Gas Generator program,

PE 0603216F (Project 681B) which is managed from the same office and provides the core gas generator development efforts This program is thoroughly integrated with the Navy work under PE 0603210N Advanced Aircraft Propulsion Systems, which is the basis for a cooperative Air Force/Navy demonstration of advanced engine technology. The Air Force and the Navy currently have a formal Memorandum of Understanding covering efforts under the Joint Technology Demonstrator Engine program. Close coordination is maintained with related efforts conducted by the Army and National Aeronautics and Space Administration. In addition, the Aero Propulsion Laboratory together with the Materials Laboratory has started a new initiative directed toward creating, in the 1990's time frame, the component technologies that will cause revolutionary changes in turbine engine technologies through FY 2010. This new initiative is called the High Performance Turbine Engine Technologies (HPTET) initiative and will focus joint resources to advanced aerodynamics, materials, and the innovative design capability such that a minimum weight, high power core technology can be achieved that offers at least 100% improvement over state-of-the-art technology. Starting in FY 1988, this effort became a part of the DOD Integrated High Performance Turbine Engine Technologies Initiative.

6. (U) WORK PERFORMED BY: This program is managed by the Aero Propulsion Laboratory of the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH. The current contractors involved in this program are: Allison Gas Turbine Division, Indianapolis, IN; Boeing Military Airplane Co., Seattle, WA; Garrett Turbine Engine Company, Phoenix, AZ; General Electric, Evendale, OH; Lockheed, Rye Canyon, CA; McDonnell Douglas, St Louis, MO; Pratt & Whitney Aircraft, West Palm Beach, FL; Teledyne/CAE, Toledo, OH; and Williams International, Walled Lake, MI.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 63202F, Aircraft Propulsion Subsystems Integration (APSI)

A. (U) Project Description: This program provides for the development and functional demonstrations for those advanced technologies which are necessary to assure propulsion and airframe compatibility, and permit the attainment of advanced performance and durability objectives in future aircraft systems. The scope of this program includes: (1) the development of advanced turbine engine components including inlets, fans, power turbines, augmentors, controls, exhaust nozzles, variable cycle concepts, and advanced design concepts; (2) the overall integration of advanced components and design concepts with advanced gas generators to form experimental demonstrator engines to define the flowpath and assess the durability/life aspects of the engine concepts; (3) the overall integration of advanced components, materials manufacturing methods and innovative design concepts to demonstrate unique, small, limited-life technologies for both tactical and strategic applications; (4) the definition of improved inlet/engine/exhaust system installation design criteria and propulsion integration techniques; (5) the definition and verification of the methodology to structurally design, analyze, and test turbine engines to achieve increased engine durability, performance, and reduced cost; and (6) the development of improved engine survivability characteristics. The components being developed will provide the basis for 10-15 percent reduction in supersonic cruise fuel usage,

55-75 percent fewer [illegible] 30-100 percent increase in engine thrust-to-weight, 30-40 percent reduction in engine life cycle cost and greater airflow matching potential when compared to state-of-the-art engines. These benefit can be traded off against one another to meet the specific needs of system of interest. This program provides both the critical technology baseline for future system development and a source of data for ensuring the orderly resolution of any propulsion system problems encountered with development engines.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The initial assessment of a new Joint Technology Demonstrator (JTDE) configuration at the Garrett Turbine Engine Company which emphasizes minimum parts and stage count and includes an advanced mixed flow fan component was completed. JTDE new start efforts were initiated during this time period and emphasize the achievement of a major improvement in thrust-to-weight capability, reduced parts count and higher dry supersonic cruise capability. An ongoing JTDE program included the assessment of an advanced metal matrix composite fan in a comprehensive flight envelope test effort at the new Aero Propulsion System Test Facility at Arnold Engineering Development Center. This JTDE test included an advanced integrated flame holder/spray-bar augmentor and an advanced transpiration cooled augmentor liner. The Expendible Turbine Engines Concepts (ETEC) demonstrator program continued with detailed design and fabrication of advanced component configurations for planned FY 1988-1989 testing. Fault tolerant electronic fuel controls were fabricated and initial subsystem checkout testing was completed. Propulsion integration technology and component designs for supersonic installation were completed.

(2) (U) FY 1988 Program: Technical efforts during this time frame will bring to fruition many of the previous year's programs and the preliminary design of a new generation of component technologies responsive to advanced Air Force needs as indicated by Forecast II projections. Ongoing efforts include the final preparation for the test and assessment of four ETEC demonstrators, and initial system testing of the advanced fault-tolerant electronic fuel controls. Engine testing of full authority digital electronic controls emphasizing low cost for missile applications will be conducted. Component aerodynamic and signature testing will be conducted on advanced inlet and nozzle concepts designed for advanced supercruise fighter applications. A planned FY 1987 new start in advanced inlet and nozzle concepts for both missile and aircraft application in the Mach 4-6 regime will be initiated. Designs of a new generation of Joint Technology Demonstrator Engines will be completed and hardware fabrication initiated. Cost estimate for the APSI program are based on contractual commitments which extend through FY 1989, plus historically based cost estimate for a level of effort which is included in the APSI Five Year Plan as directed the APSI Program Management Directive. New Start cost estimates are based on past competitive efforts of a similar nature.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will be a continuation of technology demonstrations from prior contracts. Initial demonstration of advanced component technologies responsive to the High Performance Turbine Engine Technology (HPTET) initiative will be conducted in a new generation of Joint Technology Demonstrator Engines (JTDE). Starting in FY 1988, the HPTE efforts became a part of the DOD Integrated High Performance Turbine Engine Technologies initiative. Advanced fault tolerant electronic fuel controls will undergo systems testing including up to 2000 hours of Combined Environmental Reliability Testing (CERT). The Expendible Turbine Engine Concepts (ETEC) programs will include the test and assessment of four ETEC demonstrators and will

continue to play a leading role in defining advanced component materials/manufacturing process assessment critical to HPTET goals for subsequent man-rated demonstrations in Advanced Turbine Engine Gas Generator and Joint Technology Demonstrator Engine (JTDE). Testing will be conducted at both subsonic and supersonic conditions. Inlet and vehicle wind tunnel testing of advanced integration concepts will be initiated for supersonic cruise fighters with both Conventional Take Off and Landing (CTOL) and Short Take Off, Vertical Landing (STOVL) models.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) Arnold Engineering Development Center/Aeropropulsion Systems Test Facility | March 1987 |
| (2) Advanced Electronic Control System (INTERFACE II) Reliability and Maintainability Demo | January 1988 |
| (3) Expendable Turbine Engine Concepts Demo | October 1988 |
| (4) JTDE High Efficiency Swept Fan Test | January 1989 |
| (5) JTDE High Mach Demonstrator - Initial High Performance Turbine Engine Technologies | September 1993 |
| (6) JTDE STOVL Demonstrator - High Bleed Vectored Thrust System | February 1994 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

AMENDED FY 1988/89 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603203F*** Title: Advanced Avionics for Aerospace Vehicles
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 39,515 | 10,030 | 30,114 | Continuing | N/A |
| 69CK | Advanced Devices | **0 | 2,000 | 4,700 | Continuing | N/A |
| 69DF | Advanced Weapon | 4,655 | 1,000 | 3,860 | Continuing | N/A |
| 665A | Reconnaissance Sensors/Processing Technology | 3,712 | 1,100 | 4,550 | Continuing | N/A |
| 1177 | Non-Cooperative Identification Techniques | 3,363 | 800 | 4,100 | Continuing | N/A |
| 2334 | Airborne Radar Electronic Counter-Countermeasures | 3,758 | 0*** | 5,700 | Continuing | N/A |
| 2347 | Optical Counter-Countermeasures | 2,375 | 800 | 2,600 | Continuing | N/A |
| 2733 | Advanced Reconnaissance/Strike Radars | 12,166 | Transferred to PE 63253 | | N/A | N/A |
| 2877 | Cruise Missile Advanced Guidance | 9,486 | 2,800 | 1,804 | Continuing | N/A |
| 2345 | Airborne Imagery Transmission System | 0* | 1,130 | 1,800 | Continuing | N/A |
| 2746 | Low Probability of Intercept Communications | 0* | 400 | 1,000 | Continuing | N/A |

* Project was in PE 63253F
** Project was in PE 63208F
***Project 2334 was included in the consolidated EW PE 64241 in FY 88 at the direction of Congress.

PE: 0603203F

Program Element: 0603203F  Title: Advanced Avionics for Aerospace Vehicles
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD)  Budget Activity: 2 - Advanced Technology Development

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The threat posed by Soviet and Warsaw Pact forces is steadily increasing in both quantity and quality. Countering threats postulated for the 1990s will demand significant enhancement of our tactical and strategic avionics. This program element is the principal Air Force source of advanced aerospace avionics technology for low probability of intercept wideband data and voice communication, reconnaissance, image processing, target acquisition, precision terrain-based navigation and weapon guidance, weapon delivery, and fire control for both air and ground targets and noncooperative identification of airborne targets. The PE also addresses the development of key electronic devices for aerospace vehicle applications such as radar, weapon delivery, reconnaissance surveillance and electronic warfare at the subsystem level. Some of the devices developed include military qualified magnetic bubble memories, solid state transmit/receive modules for advanced radars, tunable laser sources, etc. Technology solutions to protect radar and electro-optical systems from the effects of enemy electronic countermeasures (ECM) are also developed and demonstrated. The PE is a Science and Technology effort.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY ($ IN THOUSANDS):

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost | |
|---|---|---|---|---|---|---|
| RDT&E | 41,900 | 36,635 | 41,643 | N/A | Continuing | N/A |

EXPLANATION: Reductions in FY 1988, and 1989 were results of budget reductions to Science and Technology PEs. FY 1987 increase was the result of a below threshold reprogramming increase.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 62204F, Aerospace Avionics, provides supporting exploratory development for this program element. Efforts transitioned from PE 62204F include work on solid state active aperture arrays for high reliability airborne radars, a family of standard high speed analog-to-digital converters for avionics subsystems and an advanced multiple target attack fire control system using synthetic aperture radar weapon cuing. Advanced component development essential to this program is received from Advanced Electronic Devices for Aerospace Vehicles in this PE, and PE 63452F Very High Speed Integrated Circuits. Project 69DF, Air-to-Air Attack Management, will feed PE 63205F, Integrated Control Avionics for Air Superiority (ICAAS) which is developing the total integrated tactical air-to-air capability for transition to the Advanced Tactical Fighter, F-15 and F-16. Project 665A technology transitions to PE64710F, Unmanned Reconnaissance Vehicle and PE 27217F Follow-On Tactical Reconnaissance System. Project 1177 efforts are closely coordinated with the Tri-Service Combat Identification System program. Project 2334 transitions advanced ECCM technology to PE 64201F.

6. (U) WORK PERFORMED BY: The Air Force Wright Aeronautical Laboratories/Avionics Laboratory, Wright-Patterson AFB, OH, under the overall management of the Air Force Systems Command, Andrews AFB, MD, manages the projects in the Advanced Avionics for Aerospace Venicles program. Contractors include: Westinghouse Electric Corp, Baltimore, MD (Project 2334); Hughes Aircraft Company, El Segundo, CA (Projects 665A, 69DF, 1177, 2334, 2347); General Dynamics Corporation, San Diego, CA (Project 2877); and McDonnell Douglas Corporation, St. Louis, MO (Project 69DF and 2877). An additional 15 other contractors have contracts with a face value of $44.3 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 69DF, Advanced Weapon Delivery. This project improves the mission effectiveness of USAF combat aircraft by extending the air-to-air and air-to-ground operational capabilities of sensors and related components, subsystems and technologies that provide improved weapon delivery while enhancing survivability. Paramount to this development is the incorporation of new fire control algorithms and integration techniques to reduce pilot work load while significantly enhancing the man/machine interface. Mission goals within the project area are increased weapon delivery accuracy, real time targeting, enhanced survivability, increased firing opportunities including new launch modes and increased probability of target kill per weapon expended, offensive system missionization for autonomous and internetted attack mission. Specific efforts include the Multiple Target Attack (MULTACK) program which completed the preliminary design and initiated the final design and development of the non-real-time (NRT) simulation. AAAM was awarded initially in late FY 1986 to develop algorithms and pilot/avionics interfaces to better equip pilots to win and survive in the high threat environment of the 1990s by providing effective multiple target air-to-air attack capability. Congressional funding reductions in FY 1988 precluded transition of AAAM to the Advanced Tactical Fighter in 1989 as planned. The MULTACK program is scheduled to complete critical design in FY 1988 and transition the NRT simulation to a real time simulation in a F-15E simulator. The completed system design will be demonstrated and evaluated by Air Force pilots in FY 1990. The AAAM program will complete preliminary software development in FY 1990 and provide this software to PE 63205F, the ICAAS program. Internetted Fire Control (IFC) efforts will be initiated in late FY 1990. The IFC program will integrate the multiple target attack and attack management algorithms from the MULTACK and AAAM programs and develop and integrate internetted, multimission aircraft. The IFC program will continue through 1993. In FY 1989, the basic AAAM program will complete preparation of a multistation man in-the-loop simulation and begin evaluation of AAAM-developed algorithms and pilot/avionics interface concepts. AAAM support of the ICAAS program will continue throughout the FY 1989 to FY 1990 period. In addition to the above programs, this project will begin investigating proposed fire control concepts for attacking relocatable targets.

B. (U) Project: 665A, Reconnaissance Sensors/Processing Technology. This project provides the technology base for new and improved targeting and reconnaissance sensors and real-time automatic target recognition and processing systems. It supports essential system improvements in fusion and automation of information processing, and support for battle management and aircrew decision making. Improved immunity to active and passive countermeasures and camouflage, concealment, and deception measures will also result. This improved automatic targeting capability will allow the

Strategic Relocatable Target mission to be accomplished. It does so by providing an improved target search and strike capability which puts any ground-based targeting option at risk. In FY 1987 the Automatic Laser Target Classification (ALTC) programs continued and demonstrated both the algorithms and hardware prototypes for automatic detection, classification, and tracking of multiple targets from laser radar imagery. Efforts are underway to test and demonstrate advanced thermal imaging focal plane arrays, the single most important component in a second generation Forward Looking Infrared (FLIR), which will be designed to optimally mate to Automatic Target Recognizers (ATRs). Concept definition studies are underway for the development of a long range automatic targeting laser radar. FY 1988 Congressional reductions are resulting in termination of one-third and delay to FY 1989 of another one-third of the programs initiated in FY 1987. FY 1989/90 marks the start of a three year effort to demonstrate all the technology necessary for an advanced dual band FLIR and also the above strategic targeting laser radar. A thrust will begin to design and develop technology for an advanced air-to-air multifunction covert sensor for Terrain Following P3I and ATF applications. A demonstration effort will begin of a novel subdiffraction resolution passive infrared imaging sensor for high altitude reconnaissance/targeting applications. This effort represents transition of a successful 6.2 technology development effort.

C. (U) Project: 1177, Noncooperative Identification (ID) Techniques. This project develops and demonstrates the avionics technology base required to achieve positive, high confidence, noncooperative identification of airborne targets at ranges compatible with our tactical air-to-air missiles, day or night, in adverse weather, and in high threat, multiple target arenas. The project is developing ID technology so that weapons can be employed at their maximum capability and not be limited by a requirement for visual identification prior to engagement. A payoff of the ID technology development is an improvement in pilots' situational awareness which results from the increased display of target related information. In FY 1987, the second phase of Ultra High Radar Resolution (UHRR) has been initiated. In this phase, target attribute data was collected using a specially modified radar during training exercises on an Air Combat Maneuvering Range, allowing minimal cost data collection. Target signatures were modeled and previously developed target recognition algorithms evaluated. The FY 1988 Congressional reductions delayed UHRR phase II completion to mid-FY 1989 and a study to establish feasibility of exploiting additional aircraft characteristics for combat identification was delayed. A demonstration program to develop air-to-air target identification using the ultra-high range resolution mode inflight in a fire control radar will be delayed to FY 1989. This three year program will demonstrate that the special waveforms are compatible with the multiple target tracking modes of an air intercept radar and that real-time processing of the multiple target identification data is possible. The FY 1989 planned program will continue the FY 1988 UHRR test program and begin development of a multispectral air target ID capability. Cost estimates are based on contracts for similar work and are Category III, Budgetary.

D. (U) Project: 2334, Airborne Radar Electronic Counter-Countermeasures (ECCM). This project develops ECCM technologies and concepts used to reduce susceptibilities of current and future airborne weapon systems to enemy electronic countermeasures and supports the USAF Airborne Radar ECCM Master Plan. In FY 1986, the program began joint Air Force/Army rooftop/flight evaluation of Passive Situational Awareness (PSA) key elements; initiated joint Air Force/Navy offensive ECCM equipment development; continued the joint Navy/Air Force ECCM assessment and data base development using the F/A-18 radar; began the Electronic Combat Multi-Function Radar (EMR) development to implement a new radar design concept established under the Adaptive Agile Radar ECCM Concept (AAREC) effort and which will integrate efforts previously developed under the Project--spread spectrum waveforms, simultaneous transmit and receive capability, PSA, adaptive/wideband system technology, and advanced ECCM techniques--to provide an airborne radar offensive ECCM capability for the 1990s. The FY 1987 program continued the development and validation of advanced ECCM techniques; continued the offensive ECCM radar development utilizing the simultaneous transmit and receive technique; continued the design of the Electronic Combat Multifunction Radar (EMR) ECCM concept; and terminated the technical effort on PSA. In FY 1988 the program continues the advanced ECCM techniques with potential transition to PE 64201F; continues the Simultaneous Transmit and Receive Technology Utilization Program (STARTUP) for development of the Offensive ECCM capability; continues the EMR program; continues ECCM simulation and analysis efforts; and initiates a radar missile ECCM integration study. In FY 1989 the program completes the validation of advanced ECCM techniques; continues the STARTUP and EMR programs; completes the radar missile ECCM integration study; and continues the ECCM simulation and analysis efforts. The FY 1990 and 1991 programs complete the STARTUP program; continues the EMR program; continues the ECCM simulation and analysis; and initiates new advanced ECCM technique developments based on new findings from ECM/ECCM vulnerability assessments. Cost estimates are based on contracts for similar R&D efforts and are Category III, Budgetary.

E. (U) Project 2347, Optical Counter-Countermeasures (OCCM). This project develops Electro-Optical (EO) CCM technologies applicable to advanced weapon/reconnaissance systems (F-15, F-16, B-1B, ATF, etc.) to reduce vulnerability and mission degradation in a hostile EO environment. The total sprectrum of EO systems is involved, such as Forward Looking Infrared (FLIR), carbon dioxide ($CO_2$) laser radars, Infrared Search and Track, laser designators, etc. In FY 1987 demonstration of Countermeasures (CM) hardened FLIR technology continued, and vulnerability assessment of Automatic Target Recognizers (ATRs) and CM vulnerability assessment of $CO_2$ sensors began. Also, an evaluation of the effects of Camouflage, Concealment, and Deception (CC&D) on current and projected target recognizer compatible electro-optical sensors (USAF/Federal Republic of Germany cooperative effort) began. Due to Congressional reductions the FY 1988 program terminates the vulnerability assessment and CM hardened FLIR demonstration, but completes the $CO_2$ sensor assessment. The FY 1989 program will continue the ATR vulnerability assessment, and will begin a three year $CO_2$ sensor demonstration of CCM techniques based on the above completed $CO_2$ sensor CCM assessments. The FY 1990 program will complete the ATR vulnerability assessment, continue the $CO_2$ sensor CCM demonstration, and initiate the three year multisensor exploitation development. This effort will combine the past-proven technologies of this project (FLIR, $CO_2$ laser radar, ATR, etc.) to define and demonstrate a sensor which is "hardened" against all battlefield countermeasures.

F. (U) Project 2877, Cruise Missile Advanced Guidance (CMAG). This project develops navigation and guidance technology needed for low altitude cruise missile penetration of high-threat environment and for precision attack of high-value targets. The multipurpose $CO_2$ laser radar guidance technology will provide: 1) precision terminal homing for delivery of nonnuclear warheads, reduction of collateral damage in sensitive target areas, and destruction of hard strategic targets with smaller nuclear warheads; 2) improved midcourse navigation to increase route flexibility and reduction of mission planning time and cost; 3) terrain following/obstacle avoidance to enable reduction in flight altitude and corresponding increase in missile survivability; 4) mobile target identification/submunition aiming for attack of multiple strategic relocatable targets; and 5) retargetting of previously attacked but undamaged critical targets. The program includes design, fabrication, and flight test demonstration of two competing brassboard guidance systems. In FY 1987 development of flight test units were completed and flight test demonstration was initiated for the highest priority functions. Participation by Defense Mapping Agency, Defense Intelligence Agency and potential using commands was increased for validation of mission planning approach and identification of preferred weapon applications. CMAG for low altitude cruise missiles is finished in FY 1990, with completion of comprehensive captive flight test of all guidance functions and development of performance prediction models. These tests continue in FY 1988/89. Project 2877 concludes in FY 1990 with transition of CMG technology to follow-on conventional cruise missle (CCM) development at the Armament Division, Eglin AFB.

G. (U) Project 2345, Airborne Imagery Transmission (ABIT) System. This project provides advanced air-to-air data link technology required to counter the Soviet and Warsaw threat of 1990s and beyond. Program emphasis is directed toward low probability of intercept (LPI) air-to-air links by use of wideband and extremely wideband spread spectrum modems, narrow beam antenna acquisition, reacquisition and tracking technology, error detection and correction systems, radio frequency absorption, propagation phenomena and use of optical wavelengths. These technologies are being developed stressing a modular architecture to allow module insertions and enhancements as new technologies and threats arise. The program emphasizes high data rate imagery and/or wideband digital data transfer with companion operator/pilot voice for short to long range tactical and strategic reconnaissance communication applications and completed and delivered in FY 1986, and subsequently flight tested by the F-16 System Program Office (SPO) in support of the Advanced Tactical Airborne Reconnaissance System (ATARS) program in the fourth quarter of FY 1987. The FY 1988 planned program includes continuation of the jam resistant (JR), LPI, air-to-air ABIT System Development. The FY 1989 program concludes development and fabrication of the brassboard ABIT data link system and begins integration of the air-to-air and air-to-ground data links. The FY 1990 program begins flight test of the JR, LPI, air-to-air-to-ground data link and begins Inter/Intra Flight Situational Awareness Data Link (IFSADL) design, development and fabrication. An interim IFSADL flight test will be performed with the ABIT data link to demonstrate and evaluate air-to-air attack multiple sensor fusion algorithms between two cooperating aircraft, if funding permits. The IFSADL development will demonstrate a multiple antenna aperture per vehicle, multiple vehicle, LPI, LPD, secure, low observable (LO) data link to complement LO aircraft development programs. The IFSADL design and development will stress modularity, use of Joint Integration Avionics Working Group (JIAWG) common modules and use of Integrated Communication, Navigation, Identification Avionics (ICNIA) flexibility and reprogrammability to provide tactical forces with an affordable upgradable IFSADL system. Cost estimates are based upon the costs of similar contracts and are Category III, Budgetary.

H. (U) Project: 2746, Low Probability of Intercept (LPI) Communications. As future aircraft make increasing use of low observable (stealth) technology, the radio signals from the aircraft communications systems become the "weak link" relative to the detectability of the aircraft. This program will provide the jam resistant LPI communication system technology necessary to reduce the physical vulnerability of airborne platforms to detection, location and subsequent destruction through exploitation of radio signals. This technology program will augment other low observable avionics programs by ensuring that communication emanations are not the "weak link" to negate the effectiveness of stealth vehicles. The Air Force has ongoing programs to develop an antijam (AJ) communication capability, e.g., Joint Tactical Information Distribution System (JTIDS). This future spread spectrum radio waveform will provide some LPI capability; however, the high transmission power required to achieve an AJ capability is not consistent with the need for reduced avionics and communications observables. This project was created to address this need and at the same time support Tactical Air Force Required Operational Capability 321-75, Jam-Resistant Secure Voice Communication. The FY 1986 program completed low probability of intercept (LPI) technology assessment, electronic support measures design and vulnerability assessment efforts; initiated development/fabrication of a multimode LPI communication terminal brassboard to demonstrate the feasibility of integrating multiple LPI communications techniques; and continued test planning. In FY 1988 and beyond, the program refines the LPI communications techiques and signal structures based upon the the test results and prepares the signal waveforms for integration into the advanced Integrated Communication, Navigation, Identification Avionics systems. Cost estimates are based upon the costs of similar contracts and are Category III, Budgetary.

I. (U) Project: 69CK Advanced Devices This project is the principal Air Force source of key electronic device development for aerospace vehicle applications such as radar, weapon delivery, reconnaissance, and electronic warfare at the subsystem level. The requirements for devices developed in this project stem from purely military needs that cannot be satisfied by commercially available devices. Advanced electronic devices developed in this project include military qualified magnetic bubble memories, solid state transmit/receive modules for airborne radars, tunable laser sources and detectors for airborne electro-optical countermeasure applications, and power supplies for low voltage, high current Very High Speed Integrated Circuit (VHSIC) applications. In FY 1988 solid state active element phased array antenna development using hybrid technology will be completed. The Monolithic Microwave Integrated Circuit (MMIC) technology based radar module effort began in FY 87. Fabrication and test of the thermo-electrically cooled detector will be completed in FY 1988. Power supply circuit design and fabrication of essential power supply components for use in submicron VHSIC radar processors completion and demonstration in the laboratory will be delayed until FY 1989 due to past budget reductions. Lab demonstrations of military qualified magnetic bubble memory devices will be completed by the end of FY 1988. Work will be initiated on advanced analog to digital signal processors providing high speed, real-time outputs for airborne radar and other avionics functions, based on VHSIC submicron technology. In FY 1989 development will continue on the multifunction, frequency agile source for application to electro-optics countermeasures, laser radars, laser communications, guided bombs and range finders. In FY89, work will begin on development of a wideband (multi-octave) multifunctional (Radar/EW) active array antenna, high reliability onboard modular power supply for submicron VHSIC using designs and components developed in FY88, and chip integration of multifunctional GaAs circuits.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The United States Air Force and the Ministry of Defense, Federal Republic of Germany, have established a cooperative Project of Research in the Field of Camouflage, Concealment and Deception (CC&D) Techniques pertaining to the Infrared Spectrum and related to Fixed and Mobile Military Installations. The principal participants are the Avionics Laboratory at Wright-Patterson AFB, OH and the Forschunginstitut fur Optik (FfO) in Tubingen, GE. Each participant is funding their own research. There are no plans for exchange of funds. The United States is presently spending about $700,000 per year in this area. Cooperation thus far has been in the form of joint data collection episodes in Germany with U.S. and German crews sharing the data collection tasks and, after data reduction, exchanging reports. The Memorandum of Understanding under which this cooperative effort exists was signed in 1986 and will expire (unless renewed) in 1991.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603205F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aerospace Vehicle Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 20,937 | 20,602 | 21,439 | Continuing | N/A |
| 2251 | Nonnuclear Survivability Technology Development | 1,460 | 0 | 0 | 0 | 9,320 |
| 2506 | Control of Flight | 12,605 | 12,585 | 12,265 | Continuing | N/A |
| 2507 | Vehicle Equipment | 400 | 0 | 500 | Continuing | N/A |
| 2508 | Aeromechanics | 0 | 0 | 1,700 | Continuing | N/A |
| 2899 | Aircraft Battle Damage Repair | 944 | 606 | 0 | 0 | 8,368 |
| 2978 | Reliability and Maintainability for Flight Vehicle Technology | 942 | 3,600 | 4,940 | Continuing | N/A |
| 3416 | Boost Glide Vehicle Technology | 2,249 | 0 | 0 | 0 | 2,271 |
| 3422 | Integrated Control/Avionics Technology | 2,337 | 3,811 | 2,034 | Continuing | N/A |

NOTE: In FY 1987 Congressional PE consolidation merged PE 0603244F (Aircraft Nonnuclear Survivability) with PE 0603205F and changed title of PE 0603205F to Aerospace Vehicle Technology. DOD moved Project 2251 to PE 0605132D in FY 1988 and Project 2899 was terminated in FY 1988 due to budget cuts.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program develops subsystems that address specific aspects of the aerospace mission (tactical delivery, air superiority, and air defense). These subsystems are then incorporated in large scale system integration and flight validation programs (primarily Advanced Flight Technology Integration, PE 0603245F). For example, in PE 0603245F, subsystem integration of flight and propulsion control combined with vectored thrust provides improved air combat maneuverability, increased range and performance and a short takeoff and landing capability. Subsystem integration is essential for realizing synergistic effects of technologies in flight control, fire control or avionic sensors, structures, and aerodynamic configurations development under PE 0603205F. This program element provides subsystems to, and works in conjunction with, PE 0603245F to integrate and flight validate overall systems payoffs and performs component technology development studies/analysis in support of user requirements. This combination has been highly successful in transitioning technology into weapon systems. The individual efforts in this program element are timed to meet the technology needs of both existing and planned future weapon system acquisitions. Project 2508 is supporting the advanced wing technology work in PE 0603245F, Project 2568 and is not a new start. This is a Science and Technology program.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

Program Element: 0603205F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aerospace Vehicle Technology
Budget Activity: 2 - Advanced Technology Development

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 21,657 | 27,220 | 28,260 | Continuing | N/A |

EXPLANATION: FY 1988 differences are due to FY 1988 Congressional reductions. Congressional direction cut FY 1988 Boost Glide Vehicle (BGV) funding by $6.6 million, effectively terminating Air Force participation in BGV. FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority and reflects the termination of the BGV program.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PE 0603205F provides proven component technologies for subsequent system-level integration primarily within the Advanced Flight Technology Integration program, PE 0603245F. Jointly funded programs include the Short Takeoff and Landing/Technology Demonstrator, the Integrated Control/Avionics for Air Superiority program, the Self-Repairing Flight Control System (SRFCS) and the Integrated Closed Environmental Control System (ICECS) which is a program with the Canadians. PE 0603253F, Advanced Avionics Integration, also provides basic avionics algorithm development to PE 0603205F and 0603245F. SRFCS is also part of the coordinated Department of Defense effort to improve the reliability/maintainability and survivability of future weapon systems. The above efforts are coordinated with Army and Navy requirements and programs at a tri-service planning meeting held each summer.

6. (U) WORK PERFORMED BY: This program is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Flight testing is conducted at the Air Force Flight Test Center, Edwards AFB, CA, with support from National Aeronautics and Space Administration. Contractors are Boeing Co., Seattle, WA (2507, 2899, 3422, 2978); General Dynamics Corp., Ft Worth, TX (3197, 3422, 2506); McDonnell Douglas Co., St. Louis, MO (2506, 3422, 2978); Martin Marietta Corp., Orlando, FL (3422), and Garrett Corp., CAN (2507). There are eight other contractors, with total dollar value of $2 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2507, Vehicle Equipment. This project develops component technology for an aircraft Integrated Closed Environmental Control System (ICECS) used to provide aircraft cockpit cooling without feeding off of the ir-craft engine. This approach provides better cooling and a 5 percent fuel savings over conventional aircraft engine driven cooling units. This is a joint Canadian, Industry, and Air Force project. In FY 1989 the ICECS pod and the aircraft modifications will be designed.

B. (U) Project: 2508, Aeromechanics. This project develops component technologies for a Hybrid Laminar Flow wing system. Here leading edge suction via closely spaced slots at the leading edge of the wing is exploited to maintain a uniform nonturbulent airstream over the wing. Directly applicable to long-range transports, Hybrid Laminar Flow

reduces drag and increases aircraft loiter time by approximately 15 percent. This is a joint NASA/Air Force program. Boeing 757 flight test hardware fabrication will be accomplished during FY 1989.

C. (U) Project: 2978, Reliability/Maintainability For Flight Vehicle Technology. This project develops component technologies for a Self-Repairing Flight Control System (SRFCS). This consists of reconfigurable flight control and artificially intelligent maintenance diagnostic technologies. Self repair will cut flight control system maintenance to one-seventh of what it is today, increasing aircraft availability and warfighting capability. Using the inherent redundancy in the available flight control surfaces it will automatically reconfigure the remaining flight control system components to maintain safe flight. Automatic reconfiguration is estimated to be four times safer than today's systems based upon redundancy. To aid flight line maintenance the defective component is identified by the diagnostic system, which then specifies failure effects on the aircraft and the impact on mission/safety requirements. In combat, the system will reconfigure around battle damage and notify the pilot of the remaining flight control capability. System-wide integration and flight test is accomplished in PE 0603245F. In FY 1987 the AFTI/F-16 computer model and SRFCS was expanded to cover a large portion of the flight envelope and subjected to sensitivity analyses to establish a baseline for the design criteria experiment. The advanced reconfiguration strategy was integrated with a realistic Advanced Tactical Fighter computer simulation and operated in realtime. The Expert Maintenance Diagnostic System was expanded to cover 50 percent of the F-16 flight control system. In FY 1988 the advanced reconfiguration strategy will be fully programmed and operated in real-time simulation tests. An in-house simulation capability supporting single surface flight testing will be established. A field model of the partial F-16 expert maintenance diagnostic system will be set up at a Tactical Air Command Wing for user assessment and feedback. The laboratory version will be upgraded to 100 percent of the F-16 flight control system. In FY 1989, the design criteria for a self-repairing flight control system, including a reconfigurable flight control design and an expert maintenance diagnostic system, will be produced and available to the Advanced Tactical Fighter. Beginning in FY 1989 and continuing through FY 1994 an aggressive program for the multi-axis (Phase II) flight test effort will be pursued. At the same time, examination of the interaction of the SRFCS with other automatic modes will be conducted to upgrade the design criteria This software development in the Ada language will be made available for the initial design or retrofit of future aircraft. An evaluation program of the full stand alone F-16 ground expert system will be initiated Data will be collected in before-and-after snapshots of the maintenance process and necessary improvements will be made in the expert system based on personnel use and experience. The Integrated Environmentally Engineered Electronics (IEEE) program is a component technology program that is applicable to all types of electronic flight vehicle equipment systems. The use of the technology from the IEEE program will increase electronic equipment reliability, availability, and durability. This program will develop and demonstrate a fracture mechanics approach that will make electronic equipment twice as environmentally robust and durable. Such equipment will meet the integrity requirements of Air Force R&M 2000. In FY 1987 the IEEE contract was awarded to demonstrate this technology on F-15 radar equipment. In FY 1988 specific shop replaceable units will be examined in depth to characterize their latent defect population. Fracture mechanics models, inspection, and test criteria will be developed of the significant defect types. In FY 1989, test speciments will be fabricated and an aggressive durability testing program will begin to generate data for correlation with the analytic fracture mechanics models.

D. (U) Project: 3422, Integrated Control/Avionics Technology. This project provides supporting technologies for

the Integrated Control and Avionics for Air Superiority (ICAAS) program which are integrated and flight validated under PE 0603245F. The program develops component technologies for the engagement phase of the air combat mission. Attack guidance and control algorithms will assist the pilot with planning and execution of flight trajectories which position the aircraft for maximum probability of target kills while avoiding exposure to enemy launch zones. Defensive flight maneuvers will enhance survival against threat missiles by executing properly timed mid-course and end game evasion. Energy maneuverability algorithms will maximize aircraft maneuver potential and minimize transition time between different flight conditions. Control solutions must be computed in real time, unpredictable to the enemy, and must minimize decision errors due to incomplete or imprecise sensor data. Flight trajectories will be displayed to the pilot for manual control or coupled to the flight control system if selected by the pilot. Algorithms are designed which improve multi-sensor data processing, and cockpit information displays are modified to give the pilot a clear picture of the battle going on around him. This enhances pilot situation awareness and allows informed engagement decisions. Exchange of data between friendly fighters will be used to coordinate targeting assignments and flight trajectories to achieve maximum cooperation. The Ada high order computer language will be used for all software development in the first Ada application to real-time mission critical integrated control technology. Use of Ada is also expected to reduce the difficulty and cost of the technology transition. Simulation and flight experiments will demonstrate and evaluate the feasibility of using these technologies to a fighter outnumbered (4 blue vs 16 red) and winning with a goal of 10 to 1 exchange ratio. In FY 1987, Air Force and Navy tactical pilot evaluation of multiple target air combat engagement system software was completed. Air Combat Engagement System (ACES) uses target models to realistically simulate tactical air combat encounters with software, which can be embedded in the mission computer of a fighter aircraft. ACES can be transitioned to operational use as an embedded testing or training device which would save millions of dollars annually. Dual contracts for ICAAS technology development were awarded in September. In FY 1988, the Air Force and Navy will complete the first flight test demonstration of Ada language used in a real time integrated flight and fire control system for air-to-air gunnery. ICAAS contractors will conduct requirement definition trade studies and proceed with preliminary design definition. In FY 1989, the Air Force will evaluate preliminary designs and down select to a single contractor who will proceed to critical design and software development.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2506, Control of Flight

A. (U) Project Description: This project provides critical development of Short Takeoff and Landing technologies. Ada software language and smart diagnostics are used to demonstrate the benefits of direct linkage of the flight control system to propulsion control. Without this synergism, the workload, during combat or emergencies, exceeds the abilities of the pilot to use an aircraft's full capabilities. Subcomponents and individual technologies for a Short Takeoff and Landing/Maneuver Technology Demonstrator aircraft (modified F-15) are being developed in this project. These include subsystem development of flight controls, vectored thrust, propulsion, braking and pilot/vehicle interface in the cockpit. When integrated and flight validated in PE 0603245F, Project 2682, these technologies will produce an aircraft that can: (a) be controlled at any altitude, airspeed, or attitude by vectoring the thrust and can outperform any aircraft configured solely for aerodynamic control; (b) use vectored propulsion in-flight to enhance maneuverility and reduce fuel consumption caused by aerodynamic drag; (c) control the thrust required, while

maintaining constant engine speed, thereby allowing in-flight thrust reversing and improved energy management during combat, takeoff/landing, and cruise; and (d) takeoff and land on an icy runway, only 1500 feet by 50 feet wide, in up to a 30 knot crosswind without the aid of ground support such as a microwave or instrument landing systems. This circumvents enemy runway denial tactics or allows dispersion to austere operating bases.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Delivery of long-lead items was completed and modifications to the F-15 airframe began. This included the installation of two modified F-18 horizontal tails as canards, and modification of the aircraft tail and engine support to accommodate a rectangular nozzle for thrust vectoring. New landing gear was installed. A simulator evaluation by Air Force pilots validated the flying qualities and control law-designs in all modes.

(2) (U) FY 1988 Program: Full scale engine and control software testing will begin. Integrated Flight Nozzle Control system software development and verification activities will be completed and flight clearance for the control system and the cockpit displays will be attained. A piloted simulation with actual flight hardware to verify the development of the control system and pilot displays will include predicted flying qualities and failure modes throughout the total aircraft mission.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 the following subsystem tests will be conducted: (1) aircraft ground tests, e.g., verify stability margins, etc; (2) taxi tests of the integrated braking and steering; (3) tests to demonstrate the benefits of the control system in terms of both flying qualities and performance for both cruise and combat modes of operation; (4) tests to demonstrate the benefits of the control system and special cockpit displays for the Short Takeoff and Landing/Maneuver Technology Demonstrator (STOL/MTD) modes, including approach, guided flare to a precise touchdown, and ground rollout using maximum reverse thrust on a slippery runway in the presence of crosswind, wind shear, microbursts, and gusts. Updates to the Integrated Flight Nozzle Control software will be implemented as required. Data reduction and evaluation will provide the basis for the integration of flight/propulsion controls on the Advanced Tactical Fighter. Development of software for combat maneuver enhancement will begin. STOL/MTD will validate the benefits of integrated flight/propulsion control in combat maneuvers. Improved adverse runway and weather condition landing will be demonstrated. Tests to isolate contributions of the various individual technologies will be conducted, flight tests will develop techniques that will maximize the benefits of the technologies, determine operational usage and verify that the technologies are mature enough for operational application. Flight tests in this phase will include sorties flown by operational fighter pilots. Final program documentation will be written and transition of the technology to industry and appropriate government agencies will occur. The Integrated Control (ICON) program will develop and flight validate a fault tolerant, integrated flight and propulsion control system to optimize vehicle performance. The activity will integrate the flight control with the inlet engine and nozzle and perform ground based simulations to verify the control logic and demonstrate performance benefits. The program will also laboratory demonstrate a Vehicle Management System to significantly improve life cycle costs and operational efficiency.

(4) (U) Program to Completion: This is a continuing program. Capability of the thrust vectoring/reversing nozzles will be expanded to include aircraft yaw control. The pilot/vehicle interface, and the flight/nozzle and propulsion controls will be upgraded to accommodate the increased nozzle capability. The design, fabrication, modification, integration, and subsystem ground testing of the F-15 Short Takeoff and Landing/Maneuver Technology Demonstrator will be completed.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: The Integrated Closed Environment Control System (ICECS) project jointly develops a new aircraft cockpit cooling system with the Canadians, US Industry, and the Air Force. Funding agreements are for a $4.0 million effort split 50/50 between the Canadians, and US Industry/Air Force.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603211F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aerospace Structures and Materials
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 27,312 | 26,000 | 27,921 | Continuing | N/A |
| 69CW | Advanced Composites | 10,895 | 9,016 | 9,031 | Continuing | N/A |
| 486U | Advanced Metallic Structures | 10,224 | 7,920 | 8,671 | Continuing | N/A |
| 2100 | Laser Hardened Materials | 5,906 | 7,514 | 8,639 | Continuing | N/A |
| 3153 | Nondestructive Inspection Development | 287 | 1,550 | 1,580 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the only Air Force Science and Technology program which demonstrates subsystems and components applications in the following areas: advanced structural design concepts, new fabrication technology, hardening techniques against high-energy laser threats, and nondestructive inspection of aerospace structures. These new technologies are required to provide current and new aerospace systems the capabilities (performance, survivability, reliability, etc.) to defeat validated current and future threats. Metallic, nonmetallic, and laser hardened structures are developed with advanced materials and new fabrication technology and tested to validate technical feasibility and military utility. The result is more damage tolerant and durable structures ready for weapon systems application. Direct benefits are reduced systems cost, weight, and technical risk along with increased systems performance and survivability. This technology is directly applicable to aircraft missiles, and tactical subsystems to counter both near-and far-term threats including ground- and air-based lasers. Advanced low observable structures developed in this program directly enhances penetration and counter radar targeting for surface-to-air missile and interceptors.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 25,242 | 28,068 | 33,348 | Continuing | N/A |

EXPLANATION: (U) FY 1988 reductions are due to Congressional action. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority. These reductions will increase the time associated with transitioning of the technology developed in this program into Air Force Weapons System.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: Coordination with other Department of Defense and governmental activities is maintained under strong guidance from the Office of the Secretary of Defense's technical staff. Activities such as the Tri-Service

Metal-Matrix Composite Steering Group, the Tri-Service Laser Hardening Materials and Structures Working Groups, and selected activities of the Office of Science and Technology Policy Committee on Materials foster development of a strong nonredundant program. Close relationships are maintained with the National Aeronautics and Space Administration in areas of mutual interest. This program element is integrated with portions of the Air Force Manufacturing Technology Program (PE 0708011F) with results of each program element supporting the other, and with Aerospace Flight Dynamics (PE 0602201F), Materials (PE 0602102F), and Aerospace Propulsion (PE 0602203F), each of which provides the basic technology further development within this program element. The coordinated efforts in laser eye protection supported by Materials (PE 0602102F), Human Systems Technology (PE 0602202F), Crew Systems Technology (PE 0603231F), and Aircrew Laser Protection (PE 0604706F, Project 7207) is supported by Project 2100. In addition, the Joint Aero Propulsion Laboratory and Materials Laboratory High Performance Turbine Engine Technologies (HPTET) initiative is supported by Projects 486U and 69CW. This initiative is an effort to provide the Air force with the technology base necessary for full-scale development of engines with double the propulsive capability of current engines. Due to the universal nature of materials and structures and their application, this program element has potential application for most major Air Force acquisition programs. There is no duplication with the Strategic Defense Initiative. All high temperature structures efforts are coordinated with the National Aerospace Plane (NASP) program office to ensure that programs under this PE are complementary to, and not duplicative of NASP development efforts.

6. (U) WORK PERFORMED BY: This program is managed by the Flight Dynamics and Materials Laboratories, Wright-Patterson AFB, OH. The five major contractors include: Lockheed Aircraft Corp, Marietta, GA, Burbank, CA, (486U, 69CW); Northrop Corp, Hawthorne, CA (486U, 69CW); McDonnell-Douglas Corp, St Louis, MO, (2100, 486U, 69CW); Boeing Aircraft Company, Seattle, WA (486U, 69CW); and Rockwell International, Los Angeles, CA, (69CW). There are nine additional contractors with a total contract value of approximately $35 million.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 69CW, Advanced Composites. This project develops advanced nonmetallic structures technology (including carbon-carbon, thermoplastic, ceramic/ceramic and advanced fiber reinforced nonmetallic matrices). It demonstrates the enhanced survivability, reduced weight, and improved cost and durability payoff of these structures for both new and in-use aircraft, missile, and Air Force dedicated space system applications. System survivability is greatly increased by developing structures to defeat projected nuclear, laser, and environmental threats. Radar absorbing materials and structures and integral structure infrared attenuation concepts will significantly reduce detection and tracking threats for advanced fighter aircraft. In FY 1987 accomplishments include: the first-ever aircraft turbine engine test of a structural carbon-carbon two-dimensional nozzle, and completion of the design plans for a carbon-carbon 2D vectored thrust nozzle structures for an advanced high performance fighter engine which will validate a 10 percent thrust-to-weight improvement as well as greater service life over metallic nozzle structures; completion of full-scale wing component tests to validate durability and damage tolerance qualification methods for composite structures; fabrication of component test specimens to validate supportability of graphite/bismaleimide replacement for the EF-111 horizontal stabilizer leading edge; continuation of the development of advanced radar absorbing structures, including supportability procedures; initiation of efforts to demonstrate high temperature (2000°F) radar absorbing ceramic composite structures, develop high temperature (400°F) thermoplastic matrix composites to reduce fabrication costs and

enhance supportability and damage tolerance of next generation fighters aircraft structures, and develop low observable, infrared attenuated structure for advanced fighters and missiles. In FY 1988 efforts planned for this project include: completion of ground and flight tests of graphite/thermoplastic A-10 wing trailing edge flaps to validate reduced maintenance costs relative to the baseline aluminum flap; completion of a service qualification test of an EF-111 horizontal stabilizer leading edge (constructed from graphite/bismaleimide) to demonstrate a 53 percent reduction in maintenance costs; continuation of the development of advanced radar absorbing materials and structures (RAM/RAS), including peacetime and combat supportability requirements/methods, and infrared attenuating structures for application to advanced tactical fighter aircraft, development of high temperature thermoplastic composites to reduce fabrication and support costs for tactical fighter aircraft, development of high temperature (2000°F) radar absorbing ceramic composite structures for low observable engine exhaust nozzles and development of long-life carbon-carbon turbine engine nozzle structures for advanced tactical fighters; initiation of efforts to develop and validate mission integrated transparency systems to greatly reduce R&M costs for advanced tactical aircraft, develop advanced high temperature (3000°F) carbon-carbon and ceramic composite structures and thermal control concepts for manned high Mach weapon system engine and airframe applications, and assess the vulnerability of tactical and strategic weapon airframes to advanced laser threats. In FY 1989 several long term composite structures efforts begun in previous years will be continued. These include: evaluation of thermally resistant components, validation of low cost, high performance RAM/RAS for advanced tactical fighter applications; demonstration of reduced weight and fabrication costs for application of ceramic composites for high temperature radar absorbing structures; development of low observable infrared radar absorbing structures for aircraft and missile applications; and development of supportable RAM/RAS for the advanced tactical fighter. In support of the application of carbon-carbon in the development of 2D nozzle structures, supportability requirements and procedures for repair and maintenance will be developed and validated.

B. (U) Project 486U, Advanced Metallic Structures. This project develops and demonstrates new metallic structures technology, including metal matrix composites (MMC) and powder metals which offer the potential for significantly reducing the weight and life cycle cost of future aircraft, aeropropulsion, missile, and space systems. Improved performance is offered by developing and demonstrating advanced metallic structures which combine improved mechanical properties and manufacturing processes such as those required for current and advanced airframes and engines. These structures will also be shown to have greater reliability/durability and enhanced resistance to natural and man-made hostile environments. This project supports the Joint Aero Propulsion Laboratory and Materials Laboratory High Performance Turbine Engine Technology initiative to provide the Air Force with the technology base necessary for development of engines with double the propulsive capability. FY 1987 accomplishments include: rolling discontinuously reinforced silicon carbide-aluminum billets into the world's largest metal-matrix composite (MMC) sheets to be used in making two of the large MMC advanced fighter vertical stabilator to demonstrate 20 percent weight and cost reductions; only fabrication of an aluminum-lithium and high strength aluminum fuselage section neared completion and will demonstrate 15 percent weight and cost reductions. Air Force Logistics Command concerns for supportability of hybrid structures (organic composite surfaces and metallic substructures) will be investigated for an advanced aircraft fuselage design to demonstrate maintenance and support cost reductions of 70 percent. An elevated temperature aluminum structural demonstration program was initiated which will demonstrate 15 and 50 percent weight and cost reductions; fabrication was completed for ten titanium matrix composite turbine engine fan blades which offer a significant decrease in specific fuel consumption; titanium aluminide Metal-Matrix Composites (MMC) fan disk validation contract was awarded

to demonstrate 30 and 50 percent weight and cost reductions; a contract was awarded to investigate in-service failures of the A-10 engine inlet ring. Space structure component fabrication and modal vibration surveys were completed. This work combines passive damping and active control of space structures to reduce weight and jitter by 30 and 50 percent. During FY 1988 fabrication and structural verification testing of the aluminum-lithium and high strength aluminum fuselage component will be completed and fabrication and one half of the structural verification tests for the large MMC vertical stabilators will be completed. The Supportable Hybrid Fighter Structures Program will be awarded and preliminary design begun; a complete set of titanium matrix composite turbine engine fan blades will be fabricated for engine testing; composite turbine engine compressor disk validation design development will continue; A-10 engine inlet ring design and development testing will be completed and half of the inservice flight articles will be fabricated. Fabrication and qualification testing of F-15 titanium MMC stabilator torque boxes and superplastically formed aluminum leading and trailing edges will be completed to demonstrate 20 and 30 percent weight and cost reduction In FY 1989 the structural verification testing of the large aluminum MMC vertical stabilizers will be completed; component fabrication for the elevated temperature aluminum program will be initiated; validation test articles for the hybrid supportable structures program will be fabricated. Combined titanium aluminide MMC turbine engine fan blade and disk concept feasibility testing will conclude and concept design will be updated; A-10 engine inlet ring fabrication will be finished, and the in-service flight evaluation will be conducted to demonstrate the application of advanced technology to the user on the user's airplanes and a program combining MMC and viscoelastic damping to demonstrate 30 and 50 percent weight and jitter reductions in large space structures will continue.

C. (U) Project: 2100, Laser Hardened Materials. This project develops and demonstrates materials and design concepts for protection against laser radiation effects on tactical optical subsystems, reconnaissance subsystems, personnel, and aircraft critical components. A significant near-term threat exists to personnel and optical sensors (infrared, television, etc.) and a later-term threat to structures. Aircrew members operating tactical aircraft desperately need protection in order to eliminate the probability of being blinded by even low powered laser devices--which would cause loss of aircraft and prevent mission accomplishment. FY 1987 accomplishments include: initiation of an an effort to provide laser protection for high gain ultra-sensitive optical systems employed on reconnaisance aircraft and completion of a program to validate hardening technology and provide cost and performance impact data for the IR Maverick missile. A program developing advanced optical switching materials was initiated. FY 1988 Program Includes: completion of an effort to optimize fixed wave-length laser eye protection which feeds the Aeronautical Systems Division full scale development program for personnel protection; an effort to harden laser designated munition and a program developing hardened coatings for transparency materials. Continuing efforts include programs addressing advanced technologies for broadband protection of sensors and a program hardening reconnaissance optical systems. A key new start will develop and evaluate interim broadband protection for aircrews. Efforts will be initiated to provide laser protection for Military Airlift Command aircrews and sensors. Additional new starts include an effort to develop laser resistant transparency materials, a program to generate innovative, survivable optical designs, and a program to evaluate vulnerability of critical structural components. During FY 1989 efforts initiated in FY 1988 will continue with emphasis on broadband protection of aircrews and sensors and out of band protection of canopies and structures. The effort addressing reconnaisance optics will be completed along with the effort developing advanced optical switches for sensor protection. An effort will be initiated to investigate concepts to protect personnel from variable frequency lasers. Additionally, an effort will be initiated to demonstrate broad band protection of visible

reconnaissance sensors. Candidate technologies such as advanced optical switches, optical power limiters and "smart" filters currently being worked in the exploratory development area will be transitioned to the advanced development program for further evaluation so they can be utilized in component validation programs.

D. (U) Project: 3153, Nondestructive Inspection Development. This project develops and demonstrates advanced nondestructive inspection and evaluation (NDI/E) methods and procedures to accurately monitor performance integrity and to detect failure-causing defects and conditions in weapon system components and materials. NDI/E capabilities greatly influence and/or limit many design and manufacturing processes and maintenance practices. The planned application of significant amounts of composite materials and advanced structural high performance turbine engine alloys into the operational inventory--for example, on the advanced tactical fighter and the advanced technology bomber--demand an ability to perform real-time inspections much faster than our current capability. Comparison of Air Force inspection capabilities with requirements reveals a significant and serious deficiency. This project will examine ways to reliably detect cracks that are an order of magnitude smaller and hidden from access by other inspection methods. FY 1987 accomplishments; Initiated a five-year effort to develop and demonstrate advanced applications of x-ray computed tomography (CT). Procurement of test equipment, materials, and components are underway. FY 1988 program includes: Develop new CT methods and equipment (including backscatter, dual-energy and laminographic CT). These new techniques will be able to detect faults in complex structures and materials including Radar Absorbing Material/Radar Absorbing Structures inspection, inaccessible components, permanently closed systems (e.g., thermal batteries, electronic components, etc.) and complex cast airframe and engine components. Initial testing will demonstrate and validate accurate, cost-effective methods that meet "real-life" production and maintenance requirements. Non-Destructive Inspection/Evaluation methods relevant to Radar Absorbing Material/Radar Absorbing Structures will be investigated first. In FY 1989, the major testing and validation effort on new computed tomography equipment and procedures will continue.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/89 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603216F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aerospace Propulsion and Power Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 23,694 | 26,999 | 32,666 | Continuing | N/A |
| 2480 | Aviation Turbine Fuel Technology | 1,425 | 1,600 | 0 | Continuing | N/A |
| 2697 | Atmospheric Propulsion Concepts | 837 | 1,740 | 3,600 | Continuing | N/A |
| 3035 | Aircraft Power Systems | 1,157 | 1,992 | 3,200 | Continuing | N/A |
| 3036 | Battery Technology | 40 | 367 | 0 | Continuing | N/A |
| 681B | Advanced Turbine Engine Gas Generator (ATEGG) | 20,235 | 21,300 | 25,866 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element contains five projects. These five projects ensure a continuous development and demonstration of the most advanced turbine engine high pressure core components, advanced airbreathing concepts such as ramjets, airturboramjets and combined cycle engines, the fuels for turbine engines and advanced airbreathing concepts, and advanced power technology for all Air Force aerospace vehicles. Technology demonstration in these areas enhances low risk transition of these technologies to aerospace applications. By testing and assessing performance, durability, and reliability characteristics, advanced Air Force vehicles will be able to achieve higher payload, increased maneuverability, increased probability of kill, increased survivability, and improved operability. Anticipated technology advances from this program include 35-60% reduction in aircraft takeoff gross weight and more than 100% range increase compared to state-of-the-art technology, on the order of 50% increased averaged missile velocity and terminal velocity for enhanced end game capability, new fuel options to support advanced hypersonic vehicles flying three to six times the speed of sound, advanced aircraft power providing 8000 pounds per square inch nonflammable hydraulic system, cold weather engine starting at -65°F from present capability of +12°F, and advanced power subsystem technology responding to R&M 2000 goals, improved sortie generation, and mission completion capability. This is a Science and Technology effort.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 28,884 | 33,719 | 37,823 | Continuing | N/A |

EXPLANATION: (U) FY 1989 funding reflects Air Force budget reductions. FY 1987 and 1988 funding reduced by Congressional actions and Air Force undistributed reductions. These reductions have resulted in the elimination of efforts in projects 2480 Aviation Turbine Fuel Technology and 3036 Battery Technology during FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: Technology feasibility and practicality are demonstrated initially in exploratory development under PE 0602203F, Aerospace Propulsion. The turbine engine subsystems such as controls, fans, fan drive turbines and afterburners which, when added to the basic gas generator complete the engine, are demonstrated in advanced development under PE 0603202F, Aircraft Propulsion Subsystems Integration. Close coordination will be continued with the Navy; Army; National Aeronautics and Space Administration (NASA); Interagency Advanced Power Group; Joint Army, Navy, NASA, Air Force (JANNAF) Interagency Propulsion Committee to ensure that resources are effectively utilized for common needs. Current and planned development efforts by the Navy Advanced Propulsion Program (PE 0603210N), the Aircraft Propulsion Subsystem Integration Program (PE 0603202F), Materials Laboratory (PE 0602102F) Manufacturing Technology (0708011F), and Aerospace Structures and Materials (PE 0603211F) directly complement Project 681B effort. In addition to these standing efforts, the Aero Propulsion Laboratory together with the Materials Laboratory has started a new initiative directed toward creating, during the FY 1990's time frame, the component technologies that will cause revolutionary changes in Advanced Turbine Engine Gas Generator (ATEGG) technologies through FY 2010. This new initiative is called the High Performance Turbine Engine Technologies (HPTET) initiative and will focus joint resources to advance aerodynamics, materials, and the innovative design capability such that a minimum weight, high power core technology can be achieved in the ATEGG program, that offers improvements of at least 100% over state-of-the-art engine technology. Starting in FY 1988, this effort became a part of the DOD Integration High Performance Turbine Engine Technologies Initiative. Project 2480 supports fuel assessments conducted in the Air Force's Operational Validation Program, PE 0701112F. Test fuel acquisition transportation and storage is managed by the Defense Fuel Supply Center of the Defense Logistics Agencies.

6. (U) WORK PERFORMED BY: The program is managed by the Aero Propulsion Laboratory, Wright-Patterson Air Force Base, OH. The top seven contractors currently involved in this effort are: Teledyne CAE, Toledo, OH; General Electric, Evendale, OH: Pratt and Whitney, West Palm Beach, FL; Garrett Turbine Engine Co, Phoenix, AZ; and Boeing Military Airplane Co, Seattle, WA; Atlantic Research Corp., Gainesville, VA; and Hercules Inc., McCregor, TX.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2697, Atmospheric Propulsion Concepts. This project will initially develop and integrate the engine components (inlet, gas generator/valve, booster, ramburner) required to realize a variable flow ducted ramjet (VFDR) engine using a solid hydrocarbon fuel. Engine performance will be extensively evaluated and documented through a ground test program which includes environmental and freejet wind tunnel tests. This program, initiated in FY 1987, will provide the Air Force with advanced missile propulsion capability in the 1990s to meet the expanding threat. Initial engine design and performance requirements were established in FY 1987. Changes and/or improvements required in components previously investigated in exploratory development were defined. In FY 1988, the VFDR effort will continue with the development of airframe/propulsion interface specifications and component testing. The design, structural analysis, and specifications for an inlet/aero test will be accomplished in FY 1989. Component development for the gas generator/ valve, booster, and port cover will proceed along with preliminary ramburner performance tests which incorporate initial integrated design features. The later component and ramburner tests will provide guidance for accomplishing direct connect ramburner performance verification tests in FY 1989-1991. Inlet cover and port cover testing will be completed in conjunction with the engine documentation test series and initial environmental testing in FY 1992. The program will complete development through a Phase II environmental engine documentation test

series, and accomplish final performance verification in freejet ground tests. Mission analysis will be performed as appropriate.

B. (U) Project: 3035, Aircraft Power Systems. This project is currently developing and demonstrating a high pressure nonflammable hydraulic power system for advanced tactical and strategic aircraft, applicable to all future aircraft. Demonstration of this compact hydraulic system using nonflammable fluid and operating up to 8000 pounds per square inch (psi), will facilitate the application of low internal volume, thin wing technology, and provide significant weight savings for next generation fighters. FY 1987 efforts included the design of the 8000 psi hydraulic system. Design and fabrication of critical system components (nozzle and control surface actuator, compatible seals, and force motors to replace hydraulic pumps), along with design and fabrication of the prototype system for ground testing, was initiated. The design paid specific attention to reliability and maintainability issues, as well as to performance considerations. Preliminary concepts promise simplified hydraulic systems, weight savings, and elimination of the hydraulic fluid related fire hazard. FY 1988 goals include continuation of the ground demonstrator fabrication and initiation of component testing. FY 1989 goals include the continuation of the component tests to demonstrate acceptable design and performance and completion of the functional checkout test of the ground demonstrator. Also, a 500 hour durability test will be initiated on the ground demonstrator. Development of improved aircraft engine starter technology for low temperature, multiple starts will be delayed until FY 1990. These project efforts are aircraft related and do not duplicate any Strategic Defense Initiative work.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 681B, Advanced Turbine Engine Gas Generator (ATEGG)

A. (U) Project Description: This Advanced Development Program will ensure that turbine gas generator technology is available to meet the requirements of future aircraft propulsion systems. To ensure that these needs can be met requires a better definition of the engine's operating environment; advanced designs that maximize the trade-offs between performance and life characteristics within this environment; and effective test and measurement techniques to verify this capability. The gas generator is the basic building block of the engine and it consists of a compressor, a combustor, and a high pressure turbine which powers the compressor. The objective of this program is to provide the continued evolution of the most advanced core engine technologies (compressors, combustors, and turbines) into an advanced gas generator in which the performance, cost and durability aspects can be assessed in a real engine environment. This critical hardware demonstration will enhance the early low risk transition of these technologies into engineering development where they can be applied to growth systems and/or new systems. The technologies are scalable, flexible, and applicable to a large range of potential systems applications. Flight size, flight weight gas generators are initially tested to define flow path characteristics. Once the flow path has been characterized and mechanical integrity verified, the gas generators are subjected to accelerated life testing to characterize the structural aspects of the advanced component designs. New component technologies are introduced on a step-by-step basis so their individual performance/structural characteristics can be assessed and the relationship (effect) of the new component on other components and the integrated gas generator can be accurately assessed.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: During FY 1987 new flow-path designs of the latest propulsion core technologies have been evaluated through extensive flow-path testing. In Advanced Turbine Engine Gas Generator (ATEGG) efforts, technologies assessed included a new generation high-through-flow compressor which offers a 50% parts reduction advanced single and dual-wall combustor designs which offer four times improvement in life capability, advanced film cooled turbine vane and blade technology for the high pressure turbine utilizing advanced monocrystal alloys with three times life capability, and incorporation of variable geometry features in all major components to improve life and performance including transient response and cycle flexibilty. Additionally, key technologies necessary for the Advanced Tactical Fighter Engine (ATFE) to be developed at acceptable risk were run in the ATEGG cores in "pre-ATFE" configurations and at much higher turbine temperature test conditions to gain insight into the specific unknowns of the technologies. This information, gathered on advanced design concepts, new materials, and component synergistic compatibility will provide insight into the reality of the ATFE expectations.

(2) (U) FY 1988 Program: ATEGG is a continuing program which evaluates the most promising and the highest risk - highest payoff advanced gas generator components and design concepts in an actual engine environment. In the FY 1988 time period, all ATEGG contractors will be conducting extensive redesign efforts. However, only one contractor will be running a key environmental characterization test on the latest component technologies which have just completed initial flow-path/performance assessment in the FY 1987 test series. This effort will provide increased confidence in the transitioning of advanced technology options which offer a three to four times improvement in life, 30% to 50% increase in specific core power energy levels, 50% to 80% reduction in number of parts, and 20% to 30% reduction in life cycle cost. These values of expected performance are compared to state-of-the art engine for a baseline. The other Advanced Turbine Engine Gas Generator (ATEGG) contractors will have to be delayed to FY 1989 or FY 1990 in order to conduct their testing. In addition, in FY 1988, a significant accelerated life and durability test will be conducted on combustor liners, advanced material compressor blading and several advanced turbine blade cooling concepts usable by Advanced Tactical Fighter Engines (ATFE). The ATEGG Project in FY 1988 will provide for the extensive incorporation, in design, of the newest technology concepts generated from the Integrated High Performance Turbine Engine Technologies (IHPTET) Initiative.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1988 program will be a continuation of the contracts that were awarded in FY 1987. In this time period, innovative component technologies that have matured through the IHPTET initiative will be going through a final design review and manufacturing process in preparation for testing. These technologies will be the first of the IHPTET initiative and represent the first step toward achieving the turn of the century capability The technologies themselves will be 25% to 30% of the weight reduction, 50% of the core power values, 50% of the durability values, and 50% of the specific fuel consumption goals expected for the turn of the century engine. During this time period as in all of the late 1980's and entire 1990's, ATEGG will be the high risk-high payoff demonstrator test bed for the most innovative and most promising Air Force and DOD propulsion technologies. The technologies that are at this time the most promising include the following: compressors made of metal matrix composites constructed of advanced intermetallic compounds and high tensile strength fibers, advanced inlet guide vanes and stators of high temperature organic compounds, single crystal high film cooling effective turbine blades, innovative bearing support systems using two frames for two rotors, high temperature oilless bearings and very high component efficiencies based upon threedimensional swept aerodynamics and very high turbine gas

temperatures. Testing of these technologies will be in FY 1990 or FY 1991.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) Complete High-Through-Flow Durability Tests | August 1988 |
| (2) Initial Innovative Component Concepts Application | September 1988 |
| (3) Major Core Power Increase Initial Demonstration | February 1989 |
| (4) Initial Non-Metal Rotor Application | September 1989 |

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603227F  Title: Personnel, Training, and Simulation Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD)  Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | # 4,072 | 8,481 | 8,038 | Continuing | N/A |
| 2363 | Advanced Visual Technology System | 1,387 | 1,060 | 1,048 | Continuing | N/A |
| 2364 | Training and Performance Data Center | 400 | 380 | 1,000 | Continuing | N/A |
| 2557 | Advanced On-the-Job Training System | * | 2,101 | 1,225 | 0 | 10,613 |
| 2743 | Aircrew Combat Mission Enhancement | 2,285 | 3,783 | 3,208 | Continuing | N/A |
| 2922 | Personnel Assessment Systems | ** | 501 | 536 | Continuing | N/A |
| 2949 | Basic Job Skills Assessment and Enhancement*** | ** | 550 | 821 | Continuing | N/A |
| 2951 | Training Decisions System | ** | 106 | 200 | 900 | 1,206 |
| 3056 | Air Combat Assessment and Debriefing System | * | 0 | 0 | 5,000 | 5,011 |

# In FY 1988, related Program Elements 0603704F and 0603751F were combined with Program Element 0603227F to meet Congressional Direction to reduce the number of Program Elements.

* Projects 2557, and 3056, were documented for FY 1987 and prior years under Program Element 0603751F.
** Projects 2922, 2949, and 2951 were documented for FY 1987 and prior years under Program Element 0603704F.
*** Efforts documented for FY 1987 and prior years under Project 2948, Occupational Analysis Program, are now included in Project 2949.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology Program funds advanced development to increase the Air Force's readiness and effectiveness by providing cost-effective solutions to problems of training, personnel acquisition and job assignment, manpower management, and human performance in weapon systems. It includes: technologies for selecting, classifying, and assigning quality men and women for Air Force jobs; advanced technical training systems to increase the efficiency and productivity of Air Force personnel; technologies to estimate manpower, personnel and training requirements for weapon system design trade-off decisions and to enhance supportability of new weapon systems; and technologies to improve aircrew combat skills training. Also included in this program

element is the Air Force portion of funding for the Tri-Service Defense Training and Performance Data Center in Orlando, Florida. This program responds to Congressional and DoD mandates to update and validate tests that screen and classify military recruits, including the advanced development of the Armed Services Vocational Aptitude Battery, the selection and classification instrument for all enlisted applicants for US Armed Forces. Development and validation of these tests will lead to more accurate selection and classification of individuals and ensure an improved match of individual aptitudes and job requirements. Increased complexity of AF systems and rapidly changing technology requires development and application of advanced training system technologies for maintenance and support personnel to ensure success in combat operations. Efforts will focus upon applications of computers and artificial intelligence to training, performance measurement and job aiding, including development of intelligent computer-assisted training and low cost stand-alone training devices to support tactical, strategic, and space-related missions. A special emphasis of this program is to develop and demonstrate improved flight simulator visual image generation and visual display technologies to provide more adequate scenes for combat mission training, a low cost, highly transportable, combat mission trainer for use at squadron level, and the technology to link numerous trainers at dispersed locations, to enable realistic, large-scale, joint service combat training exercises. Technology development efforts also support in-aircraft combat training through the development of an air combat assessment and debriefing system, similar to that provided at the instrumented combat ranges, which will provide significant improvements in home base pilot training and performance.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Total RDT&E | 7,475 | 10,902 | 12,743 | Continuing | N/A |

EXPLANATION: (U) The FY 1988/1989 Descriptive Summary, for comparability purposes, included FY 1987 funding for projects documented under Program Elements 0603704F and 0603751. This consolidated Program Element 0603227F now consists of funding for all projects formerly documented in Program Elements 0603227F, 0603704F, and 0603751F, except Project 3057 from Program Element 0603751F which, through administrative error, has not yet been transferred. The FY 1988 differences are due to Congressional action. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority. FY 1988 and FY 1989 reductions will delay, until FY 1991, the continued development of an air combat assessment and debriefing system, which would provide objective performance evaluation for local area training. Efforts to develop advanced flight mul. or technology to support realistic multi-aircraft combat training have been delayed and significantly reduced i. ... ront end analyses for mission rehearsal simulation and modular threat simulator design were cancelled; developm ... low fidelity pilot stations have been delayed by one year; the planned R&D network was reduced from seven full-coc... pilot stations cockpits to four. Development of job performance measures for four Air Force specialties, to link enlisted standards to on-the-job performance was also cancelled. Validation of the Armed Forces Vocational Aptitude Battery for civilian occupations will be delayed and reduced in scope.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Military Construction: | | | | | |
| Funds | 4,900 | 0 | 0 | 0 | 4,900 |

5. (U) RELATED ACTIVITIES: Related program elements: 0601102F, Defense Research Sciences; 0602201F, Aerospace Flight Dynamics; 0602202F, Human Systems Technology; 0602204F, Aerospace Avionics; 0602205F, Personnel, Training, and Simulation; 0603253F, Advance Integration Avionics; 0603259F, Cartographic Applications; 0603751F, Training Systems Technology; 0604227F, Flight Simulator Development; 0602717A, Human Performance Effectiveness and Simulation; 0603216A, Synthetic Flight Simulators; 0603731A, Manpower and Personnel; 0603738A, Non-Systems Device Development; 0602757N, Human Factors and Simulation Technology; 0602763N, Personnel and Training Technology; 0603707N, Manpower Control System Development; 0603720N, Education and Training; and 0603733N, Training Device Technology. Air Force efforts directed toward improvement of the Armed Services Vocational Aptitude Battery and the production of new forms of that test are directed, in part, by a Tri-Service steering committee of General Officers. Similarly, efforts concerned with the development of computerized testing techniques, for eventual implementation at Military Enlistment Processing Stations, are coordinated with the Army Research Institute (ARI), Naval Personnel Research & Development Center (NPRDC), and the Center for Naval Analysis. Air Force responsibilities lie principally in the development of test items suitable for computer implementation. Efforts across all Services to develop job performance measures are coordinated by a working group monitored by the Office of the Assistant Secretary of Defense for Force, Management and Personnel. Close coordination is maintained both at the working level and by laboratory management with ARI, NPRDC, the Army Program Manager for Training Devices, and the Naval Training Systems Center. Exchange of proposed statements of work for contractual efforts, wide dissemination of technical reports, and attendance at symposia and meetings ensure that work conducted within this program element benefits from and does not duplicate work conducted by the other Service laboratories. The Air Force Human Resources Laboratory closely monitors all significant research and development being conducted by other DoD, NASA, and industrial organizations in order to prevent duplication of effort. Close coordination within the Air Force user community is also accomplished by annual research and development coordination meetings between the Laboratories, the Aeronautical Systems Division, and the Major Commands.

6. (U) WORK PERFORMED BY: This program is managed by three divisions of the Air Force Human Resources Laboratory: The Manpower and Personnel Division, Brooks AFB, TX; the Operations Training Division, Williams AFB, AZ; and the Training Systems Division, Brooks AFB, TX. The Operations Training Division has an operating location at Davis-Monthan AFB, AZ, in support of Project 3056, and the Training Systems Division has an operating location at Bergstrom AFB, TX, in support of Project 2557. The major contractors are: Singer Company, Binghamton, NY (Projects 2363 and 2743); General Electric Company, Daytona Beach, FL (Projects 2363 and 2743); University of Dayton, Dayton, OH (Projects 2363 and 2743); Canadian Commercial Corp, Ottawa, Canada (Projects 2363 and 2743); and McDonnell Douglas, St Louis, MO (2557). There are four additional contractors with contracts totalling $2.5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2363, Advanced Visual Technology System (AVTS). This project develops technology to advance the state-of-the-art in visual simulation technology and demonstrates the utility of this technology for critical Tactical Air Force training requirements. From 1981 to 1986, this project has produced: this country's most advanced computer image generator for flight simulation, which significantly increased scene detail, complexity, and realism; a prototype Fiber-Optic Helmet-Mounted Display, which uses lightweight optics to present the computer-generated image on glass plates directly in front of the pilot's eyes; and a 24-foot-diameter limited field-of-view dome visual display system. The advanced visual technology system image generator and the Fiber-Optic Helmet-Mounted Display have been transferred to Project 2743, Aircrew Combat Mission Enhancement (ACME), for integration into the ACME testbed complex. In FY 1987, the limited field-of-view dome display system was equipped with an F-16A cockpit to produce a flight simulator for evaluating the training effectiveness of current technology. Training effectiveness issues to be investigated in FY 1987 through FY 1989 are: simulator fidelity questions (such as the required field-of-view, display resolution, image brightness and image contrast), image generator scene content, gaming area data base accuracy requirements, target model fidelity requirements, and the most effective use of color in flight simulator training. In FY 1987, a major new hardware effort was the development of the next generation full field-of-view dome visual display system, a $4.5 million, three year project, jointly funded by the Aeronautical Systems Division (Project 2325, PE 0604227F). Current full field-of-view dome displays suffer from limited resolution and brightness and use target tracked insets (a small, higher resolution area, centered on the target, which moves as the target moves) and are limited to simulation of air-to-air combat. The object of this new development is to exploit current head-tracking techniques to project a high resolution area of interest inset wherever the pilot is looking within the dome. This will provide high detail scenes to the pilot which are suitable for both air-to-air and air-to-ground combat simulation, without generating false cues to target location, as occurs with target tracking insets. The modular design will allow for incorporation of eye-tracking when that technology matures. Installation and integration of the dome will be completed by FY 1989, with training effectiveness evaluations beginning in FY 1990.

B. (U) Project: 2364, Training and Performance Data Center. This project provides the annual Air Force portion of the funding for the Tri-Service, Defense Training and Performance Data Center (TPDC), formerly Defense Training Data and Analysis Center, established in FY 1984 by direction of the Office of the Secretary of Defense (OSD), as a result of the 1983 OSD Steering Committee on Training and Training Technology. TPDC is the OSD focal point for training technology and management information and will collect available training data to design, analyze, and integrate training data bases in support of the entire DoD training community. In FY 1987, TPDC developed a key wording system, using artificial intelligence techniques, which allows the user more rapid entry and access to training related data. TPDC also developed a concept for a training information decision system that integrates several large data files and produces occupational data files for personal computer applications. Also in FY 1987, TPDC supported the data collection and system maintenance efforts of the USAF's Advanced On-The-Job Training System (AOTS) R&D program (Project 2557, PE 0603227F). In FY 1988 and FY 1989, this project supports seven major projects: Performance Measurement, Task Data Base, Applied Instructional Technology, Collective Unit Training, Occupation Data Base, Footprint/Crosswalk, and Operational Equipment Training System. TPDC also plans to continue supporting the AOTS program in FY 1988 and FY 1989.

The USAF has direct sponsor involvement in the development of data and tools for occupations, applied technology, and support for weapon system training in the Crosswalk project.

C. (U) Project: 2557, Advanced On-the-Job Training System (AOTS). Approximately 70 percent of Air Force technical training is accomplished by on-the-job training (OJT). More than 50 percent of all enlisted members Air Force-wide are undergoing OJT at any one time. However, the OJT system has not changed significantly since its inception almost 40 years ago. Currently, OJT is labor intensive, limited by excessive administrative burdens, and is not responsive enough to unique job site training requirements. This project, classified in the simulation and training devices Congressional category, will design, develop, implement, and test a prototype state-of-the-art training system that integrates and effectively develops, manages, evaluates, and automates job site training for the active Air Force, Air National Guard, and Air Force Reserves. This will increase OJT effectiveness and training quality, thereby increasing individual and unit productivity, readiness in peacetime, and combat capability in wartime. The Advanced On-the-Job Training System (AOTS) will be implemented and demonstrated for four large Air Force skill specialties at Bergstrom AFB, TX, in cooperation with Tactical Air Command. This program complements other Air Force maintenance and logistics automation initiatives. In FY 1987, the major portion of development for the AOTS subsystems was completed, training requirements were identified, and job/task data assessed. Master task lists for four Air Force skill specialties were written and a methodology for third party performance evaluation, including criteria for task evaluation, developed. FY 1988 efforts focus on integration of the Advanced On-the-Job Training System subsystems, as well as the requirements associated with maintenance, reliability, logistics, and transition of the system. During the fourth quarter of FY 1988 system test and evaluation (T&E) will begin. In FY 1989, the T&E will be completed in operational work centers and units and the prototype system will be transferred to Tactical Air Command. Throughout development incremental products will be provided to HQ USAF for evaluation and implementation Air Force-wide.

D. (U) Project: 2743, Aircrew Combat Mission Enhancement (ACME). ACME will advance tactical flight simulation and training by demonstrating and evaluating technologies for realistic tactical combat mission training, as well as combat mission planning and mission rehearsal. These demonstrations and evaluations will help define simulator requirements to meet critical Tactical Air Force needs. The basic approach requires the development of a Situational Awareness Training Research System (SATRS). This SATRS will serve as the primary tool for tactical aircrew training R&D and as a testbed for evaluating the impact of ACME components on aircrew performance. During FY 1987, tactical training needs, engineering feasibility, and system requirements were analyzed. These analyses indicated that ACME should focus its initial efforts on developing and evaluating simulator and training technologies which will lead to improved situational awareness and combat effectiveness in the multibogey tactical environment. Advanced microprocessor and digital communication technologies will be incorporated into the design of all SATRS components. The SATRS required to support this situational awareness training R&D will be developed at three levels of capability: Level I (FY 1988-1990) will refine and integrate previously developed components including two F-16 cockpits, two wide field-of-view fiber-optic helmet-mounted displays (FOHMDs), and the Advanced Visual Technology System (Project 2363) to provide a basic two-ship F-16 capability. This two-ship capability will support training R&D involving the basic tactical element. An upgraded FOHMD with increased field-of-view and an eye-tracker will be completed in FY 1988 and demonstrated in FY 1989 as part of the SATRS. Level II (FY 1989-1991) will develop: two additional cockpits and integrate them with two Project 2363 developed dome displays; a local area network; an elementary command and control

capability; additional threat and sensor systems; and six manned combat stations to allow four-ship training R&D in a multibogey environment. Level III (FY 1989-1993) will develop a long distance network standard and evaluate the potential of using long distance networking in aircrew training. Beginning in FY 1989, a Tri-Service flight simulation networking effort will be initiated with the Army Research Institute, the Army's PM-TRADE, and the Naval Training Systems Center to identify protocol requirements for long distance networking of dissimilar simulators. Beginning in FY 1993, R&D efforts will be initiated to determine the effectiveness of various mission planning and mission rehearsal approaches on mission success using the Situational Awareness Training Research System as a testbed.

E. (U) Project: 2922, Personnel Assessment Systems. This project, in the manpower and personnel Congressional category, will provide technology to enable the Air Force to meet its manpower needs for combat readiness and sustainability and for the development of systems to provide information on individual job performance and job requirements. As mandated by Congress, task-level measures of on-the-job performance will be used to validate selection, classification and promotion tests and assess training effectiveness. This project also provides advanced development for the Air Force Officer Qualifying Test (AFOQT) and other tests such as the Armed Services Vocational Aptitude Battery (ASVAB). Replacement of Service tests and test batteries is required to avoid obsolescence, to provide alternative tests for selection continuity in case of test compromise, and to incorporate improvements identified in ongoing exploratory test research programs. As the DoD Executive Agent for ASVAB development, the Air Force must ensure it meets the needs of all Services and must update and revise the test battery. In FY 1987, job performance measures for three Air Force specialties: Air Traffic Controller, Avionic Communications Specialist, and Ground Radio Operator, were tested. Analyses of these data will be completed in FY 1988. Job performance measures for four additional Air Force specialties: Personnel, Life Support, Aerospace Ground Equipment, and Precision Measuring Equipment, were developed and tested in FY 1987, with completion of the analyses in FY 1988. Development of new prototypes for both the enlisted and officer selection test batteries are continuing in FY 1988. Future efforts will explore computer-based/computer-adaptive approaches to officer selection and classification. Development, evaluation, refinement, and application of performance measures will also continue, as will validation and cost/benefit analyses of the measures. In FY 1989, job performance measures will be developed for eight additional specialties.

F. (U) Project: 2949, Basic Job Skills Assessment and Enhancement. This project, included in the education and training Congressional category, will develop and demonstrate an adaptive training system focusing on the basic functional and enabling job skills, that is, the core knowledge content, and associated thinking processes, that enable early technical proficiency and thus bring the first term airman to a functional level faster. Of particular interest are the skills required in workplaces heavily influenced by technology. This training system, incorporating data collected in Program Element 0602205F on the intellectual requirements of various jobs and workplaces, will thus provide Air Force decision makers with scientifically valid, job-oriented measurement and training, to ensure that airmen possess the basic job knowledge and skills needed to perform and progress satisfactorily during the first term of enlistment. Another effort within this project will provide a top-down, structured approach to system redesign and reprogramming to make the Comprehensive Occupational Data Analysis Programs system, more efficient, easier to maintain, and more user-friendly. Comprehensive Occupational Data Analysis Programs (CODAP), the primary operational Air Force occupational analysis tool, is antiquated and difficult to maintain. The original CODAP system has resulted in an estimated cost avoidance of over $3 million per year since its implementation in FY 1968. Benefits of the updated CODAP include: state-of-the-art analystical, statistical, and reporting procedures; techniques for longitudinal analyses of

job content; techniques for developing more job-related enlisted promotion tests; and techniques for matching weapon system acquisition tasks with related personnel skill requirements. In FY 1987, a series of advanced development tasks were initiated to develop a prototype occupational measurement system with advanced task and job clustering capabilities and automated job typing procedures; software development will be completed by the endof FY 1989. The development of training modules for 26 Air Force specialties will begin in FY 1988, and specifications for training effectiveness evaluation and validation will be completed. Comprehensive training implementation plans will also be completed in FY 1988. In FY 1989, development of a basic job skills extended job family trainer for eight Air Force specialties will be completed and tested. This technology will reduce the number of marginal performers in the Air Force and reduce overall training time. Savings from reduced attrition could reach as much as $10 million per year. Also in FY 1990, test and evaluation of the prototype occupational measurement system will begin. A thoroughly integrated and tested system will be transitioned to Air Training Command by the end of FY 1991.

G. (U) Project: 2951, Training Decisions System (TDS). This project, included in the education and training Congressional category, will provide a computer-based system which will aid in optimizing training designs for Air Force specialties. It will establish the basis for management decisions on what to train, where to train, and when to train. Because of the scope of Air Force technical training, many decisions with major impacts on training are made independently and at different times, by management activities responsible for different parts of the training and personnel systems. Coordinating such efforts is complex, and relevant data are not always available at key decision points. For example, the content of resident technical school training is largely determined by predefined budgets, and whatever content is not covered in the school is left to on-the-job training (OJT) without systematic appraisal of long-term costs or unit capacities for an increased load on OJT resources. Current practice does not include adequate consideration of all relevant factors, such as costs and alternative patterns of personnel utilization, in making basic decisions regarding the what, where, and when of personnel training. Benefits from this project include reduced training costs, improved allocations of training content and resources, better alignment of training content with job task requirements and reduced training workload on operational Air Force units. When operational, projected savings plus cost avoidance are expected to be very high. In FY 1988, design specifications will be completed. Advanced development of the TDS will begin in FY 1988. Computer-assisted decision aids describing optional ways of configuring airman jobs, training states, and career paths within given specialty areas will be completed, tested, and transitioned by FY 1992.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: A cooperative agreement exists between the United States (US) and Canada for the development of a Fiber-Optic Helmet-Mounted Display System (FOHMD) for flight simulators. The system uses lightweight optics to present high resolution, color, computer-generated images on glass plates directly in front of the pilot's eyes, thus eliminating very large and costly optics and/or domes otherwise needed to simulate the visual scene available in a modern fighter aircraft cockpit. The FOHMD will provide the flight simulator display capability required for advanced tactical training applications. This effort is a joint US/Canadian cost-plus-fixed-fee contract with the Canadian Commercial Corporation, Ottawa, Canada. Work is being performed by CAE Electronics Ltd., Quebec, Canada. The joint cost-sharing agreement has been in effect since July 1981. Through FY 1986, Canada has obligated $3.463 million

rogram Element: 0603227F Title: Personnel, Training, and Simulation Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

nd the United States has obligated $4.862 milliоh through projects 2363 and 2743, in PE 0603227F. The program is in advanced development. A lightweight eye-tracked prototype helmet mounted display was delivered to the Operations Training Division of the Air Force Human Resources Laboratory in June 1986. An upgraded FOHMD, incorporating refinements necessary for Tactical Air Command acceptance, will be completed in FY 1988, integrated into the Combat Mission Trainer testbed, and demonstrated in FY 1989. To carry the program through to completion, Canada has programmed $3.08 million in FY 1987 and FY 1988; the United States has programmed $1.681 million in FY 1987 and FY 1988. Total funding under this joint cost-sharing agreement is $13.086 million, divided evenly between Canada and the United States.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603231F Title: Crew Systems and Personnel Protection Technology
DOD Mission Area: 552-Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 16,594 | 18,242 | 22,259 | Continuing | N/A |
| 2722 | Biomedical Chemical Warfare Defense | * | 3,500 | 4,472 | Continuing | N/A |
| 2829 | Cockpit Automation Technology | 5,825 | 5,540 | 5,528 | Continuing | N/A |
| 2830 | Advanced Life Support Systems | 2,443 | 1,022 | 1,978 | Continuing | N/A |
| 2868 | Crew Escape Systems Technology | 7,826 | 6,492 | 4,022 | Continuing | N/A |
| 2992 | Space Crew Enhancement | 500 | 660 | 1,008 | Continuing | N/A |
| 3256 | Advanced Strategic Aerospace Crew Systems | 0 | 0 | 1,522 | Continuing | N/A |
| 3257 | Virtual Image Cockpit | 0 | 1,028 | 3,451 | Continuing | N/A |
| 32[illegible]1 | Human Centered Technology for Command, Control and Communications | 0 | 0 | 278 | Continuing | N/A |

* $4,946 was funded in former PE 0603475F, Chemical Warfare Defense, for this project in FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Weapons system development has reached the point where the operator may become the limiting factor in total system performance and mission success. The performance envelope of the weapons system, extreme aerospace environments and combat threats can exceed the protective capabilities of life support systems, limiting operations while placing severe physical demands on the operator. Information available concerning the status of the weapons system and mission is so complex and fluid that it can exceed the operator's ability to perceive, decide, and act on that information. Both physical and mental demands can place the operator in situations from which he cannot recover, while modern aircraft tactics and mission scenarios continually create environments from which there is low probability of successfully ejecting in an emergency. This program provides advanced development and demonstration of concepts to protect and extend the performance of the crewmember in the hazardous aerospace environment. It will demonstrate the capability to operate and escape at the extremes of the performance envelope and develop the methodology to maximize decision making by the system operator. The program focus is on the crewmember in the cockpit but logically extends to other air and groundcrew conducting mission-essential operations and support. Recently incorporated efforts on chemical warfare defense ensure integrated consideration of this serious threat to the spectrum of aerospace operations. Supporting many system development programs and over fifteen formal

air Force Statements of Need from Major Commands on specific requirements, the emphasis of this Science and Technology effort remains on total personnel protection and improved performance of human-centered systems to support mission accomplishment.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 21,054 | 23,742 | 25,250 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 estimate inadvertantly included $5,149 from PE 0603745F, Chemical Warfare Defense. That program element will no longer exist in FY 1988, but the program will continue and is now listed under PE 0603231F as Project 2722. The FY 1987 actual funding also included $486 thousand reprogrammed into Project 2868 to solve a contractor cost growth resulting from a required redesign of an ejection seat flight controller. This occurred because a subcontractor was unable to meet the performance specifications. The FY 1988 difference is due to a $5.0 million non-prejudicial Congressional delay of FY 1988 new starts. The FY 1989 reduction accommodates a decrease in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: These programs have evolved from exploratory development within PE 0602202F, Human Systems Technology, and represent a key link in the demonstration of technologies prior to full-scale development through PE 0604706F, Life Support Systems; PE 0604703F, Aeromedical/Chemical Defense Systems; or engineering program offices. Products are provided to Aeronautical Systems Division (ASD), Human Systems Division (HSD), Electronic Systems Division, Space Division, and other organizations with well-coordinated, signed technology transition agreements. Life support activities are included in ASD's Ten-Year Life Support Master Development Plan and are coordinated through the Tri-Service RDT&E Steering Group reporting to the Joint Logistics Commanders. Military space crew activities are coordinated with other services or agencies and with the National Aeronautics and Space Administration through joint participation in the Air Force Scientific Advisory Board and the Space Technology Interdependency Group, consultation on requirements, and cooperative research covered by memoranda of agreement. Laser protection technology is coordinated through the Tri-Service Laser Hardened Materials and Structures Group, chaired by Office of the Under Secretary of Defense for Research and Engineering. Man-machine integration activities are coordinated through a Tri-Service Initiative Panel chartered by the Joint Directors of Laboratories and chaired by the Cockpit Automation Technology (Project 2829) Program Office and the HSD/ASD crew station working group. Project 2722 was previously funded in PE 0603745F,

Chemical Warfare Defense. The Army is DOD lead agency for Chemical Warfare Defense, and only efforts that have specific Air Force relevance or that can be accomplished more economically using Air Force expertise are accomplished in this project. Areas with multiservice application are identified in the Joint Services Research, Development and Acquisition Plan for Chemical Warfare for inclusion in the Army's overall research program. Medical chemical defense efforts are further coordinated through the Armed Services Biomedical Research, Engineering and Management Committee. This program element is coordinated on an international basis through the Air Standardization Coordinating Committee, NATO Advisory Groups on Aerospace Research and Development, and specific Data Exchange Agreements.

6. (U) WORK PERFORMED BY: This program is conducted by the Human Systems Division, Deputy Commander, Development and Acquisition, Brooks AFB, TX, with assistance from its laboratories, the United States Air Force School of Aerospace Medicine and Air Force Human Resources Laboratory, Brooks AFB, TX, and the Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; and through memoranda of agreement with other laboratories, divisions and commands. The program is conducted principally through contracts with the following prime contractors: Boeing Advanced Systems Company, Seattle, WA (Projects 2829, 2830, 2868); Northrop Corporation, Aircraft Division, Hawthorne, CA (Project 2829), A.D. Little, Inc., Cambridge, MA (Project 2722); Bendix Corporation, Baltimore, MD (Projects 2722 and 2992); Battelle Laboratories, Columbus OH (Project 2722); one other contractor funded to $150,000.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2722, Biomedical Chemical Warfare Defense. This project began as a separate program element in FY 1982 to meet a critical need to defend our forces and sustain military operations in a chemical warfare environment. The project's goal is to ensure the protection and performance of aerospace mission and support personnel, the maintenance of combat sortie generation rates, and the adequate treatment of combat casualties. In close coordination with the Army, a set of systems analysis concepts (master plans) establish total Air Force requirements based on operational needs. Technology development plans are generated and ongoing trade-off studies conducted to meet Air Force-unique requirements through development of such technologies as: (1) Detection, Identification and Warning equipment; (2) procedures, equipment and facilities for decontamination or avoidance of toxic agents; (3) air and ground crew protective equipment or clothing compatible with aircraft design and operations; (4) collective protection systems such as crew shelters and chemically hardened aircraft environmental control systems; and (5) specific medical and air evacuation support items essential for patient care in a toxic environment. FY 1987 Accomplishments: A toxicological analysis of chemical agent training simulants was conducted. Preliminary results indicate that chloropentoflourobenzene has very low toxicity, if any at all. In addition, a persistent chemical agent training simulant has been identified. In the area of ground crew cooling systems, it was determined that air cooling is as good or better than liquid cooling. The laboratory work and a transition plan for the concept of intermittent cooling have been completed. Two breadboard Chemical Vapor Cockpit Sensors were developed. However, sensitivity goals were not achieved and it was decided to return this technology to the 6.2 level of development. Work was completed on the molecular sieves and cockpit

filtration systems. FY 1988 Program: This year will contain central efforts on a Contamination Control Systems Analysis to determine the trade-offs for decontaminating various air combat systems and to provide recommendations on where decontamination efforts should be focused. A prototype system for estimating casualties and attrition factors, successfully demonstrated at SALTY DEMO (an airbase survivability demonstration), will be developed for worldwide application in air base exercises and planning activities. Following a two-year development effort, testing and preparation for transition to full-scale development will occur for a Fixed-Site Chemical Detection and Warning System to provide real-time networked attack and contamination data. This development supports critical maintenance of air base operations during chemical attack. A post attack hazard monitoring systems analysis will be completed. It will determine what impact detection systems will have on sortie generation. An analysis will be completed to determine if there is a threat to water supplies from chemical or biological agents. A data base will be generated on the protection afforded by chemical defense masks. Students in Base Recovery After Attack training will comprise the subject pool. A thermal guide will be completed and will provide an understanding to thermal burden of working in chemical defense clothing. FY 1989 Planned Program: The contamination control systems analysis will be completed. The threat-related attrition model developed for air base survivability and operability exercises will be modified to add nuclear/biological effects, ground-launched cruise missile operation, and projected air combat losses. A competitive contract will be let to develop an in-line water detection device, provided the threat analysis anticipates the need. The Fixed-Site Chemical Detection and Warning System (FSCDWS) specification program will continue. A feasibility study for the use of light detection and ranging technology in the FSCDWS program will be conducted. Advanced development of a mask communication device will begin. This will be based upon infrared technology. A biological threat analysis will be conducted.

B. (U) Project: 2829, Cockpit Automation Technology (CAT). The CAT project provides quantitative tools and procedures to permit the application of human factors principles early in the development cycle of manned aerospace vehicles. The resulting design process will determine the cost-effective use of cockpit/crew-station automation technologies based on crew needs and mission requirements. It will also help reduce system program costs and risks currently associated with numerous cockpit engineering change proposals and retrofits. For the first time, a coordinated and auditable process will permit quantifiable trade-offs between airframe, avionics and cockpit design in advance of full-scale development decisions, as well as provide insight into the potential consequences of later modifications to avionics and weaponry. Resultant military standards, design handbooks and computer-assisted procedures will be available to the military services, NASA and contractors. FY 1987 Accomplishments: Core development continued under two parallel cost-share contracts. Trade studies on existing analytical tools and required computer aided engineering design systems converged to a support system requirement which has been fully developed and implemented. Software tools for information analysis and function analysis were completed. The process was documented to identify timing of data flow and requirements evolution. To demonstrate the process, a mission analysis of the baseline system and six new automation concepts identified crew system workload bottlenecks. Separate contractual efforts were initiated to specify requirements for a flight worthy performance and workload measurement test system, to

specify performance requirements for a helmet mounted display system, and to analyze existing simulation data to identify factors sensitive to pilot situational awareness. FY 1988 Program: Development of the crew system design process will be completed. The computer aided engineering environment with supporting software tools will be fully developed, tested and documented. Demonstration of the process for verification will converge into a tactical crew system specification. A part-mission laboratory fixture to support analytical findings will be designed. Demonstration of test and evaluation procedures using company owned assets will be performed for all deliverables. One of the two core development contractors will be selected for the demonstration and validation phase. During this phase the part mission simulator will be fabricated and integrated with the analytical computer aided engineering data bases. Award of a separate development effort will occur to address higher risk approaches to air combat information analysis and to develop procedures to support government objectives in industry run full mission simulations. FY 1989 Planned Program: Phase III, system demonstration and verification, will continue as the Cockpit Automation Technology process is refined based on results of analytical and part-mission simulation tests. Simulation will be conducted using Air Force crews in both company owned full mission simulators and the part-mission simulator developed above. Data collection and analysis systems will be developed and tested. Development of three new software tools for quantifying pilot performance, pilot workload and pilot acceptance during analysis and simulation will be developed and tested. Other software tools will be revised and upgraded. Documentation of all procedures, methods and approaches into a design guide will commence.

C. (U) Project: 2830, Advanced Life Support Systems (ALSS). This project identifies, develops and integrates advanced life support subsystems required for new aircraft or unique mission requirements. The goal is to provide advanced crew protection technology for each new aircraft or mission requirement, or as needed by the current operational forces. Given successful completion of efforts to develop a Tactical Life Support System (TLSS), project emphasis is shifting toward satisfaction of emerging requirements for an Advanced High Altitude Protective System (AHAPS) for the Strategic Air Command's reconnaisance mission. FY 1987 Accomplishments: TLSS was installed in the Cockpit of an F-15B and successfully test flown at Edwards AFB. This system uses a new helmet, mask, and integrated counterpressure garment to provide enhanced acceleration protection through the use of positive pressure breathing (PPB) under sustained accelerations. Necessary airframe modifications included installation of the system's on-board oxygen generator (OBOGS), stand-by oxygen assembly, seat-mounted oxygen regulator, control and display circuitry, electronic G-valve, nuclear/biologiacl/chemical filter-blower, and liquid-cooling unit. Parallel tests of three simplified PPB systems (adapted for the F-16) were also conducted. Post-flight de-briefs for both F-15B and F-16 included reports of greatly enhanced G-tolerance, combat advantage, reduced fatigue, and a predicted increase in sortie surge capability. After review of this program's progress, Air Force Systems Command judged the project ready for full-scale development. In an effort to stimulate technologies needed for the forthcoming AHAPS program, work was also undertaken (in cooperation with Project 2992) to develop enhanced mobility technologies that would permit the higher operating pressures desired for tomorrow's pressure suits. FY 1988 Program: Work is continuing with the goal of providing the earliest possible operational capability for acceleration protection by PPB. Refinements suggested by flight test

experience are being incorporated with the intent of returning this summer to test an improved PPB system for F-16 aircraft. Other follow-on improvements to the TLSS will include development of compatible exposure/immersion protection, an "under the visor" night vision goggle, improved laser protection, and helmet-mounted display capabilities. Full pressure suit requirements will be established from the tech base development initiated in FY 1987. Requirements will include better comfort in the unpressurized state, superior mobility at higher inflation pressures, and the ability to model the mobility requirements of a given cockpit envelope. The AHAPS contract statement of work will be prepared with contingency clauses for inclusion of a variant of the system, compatible with the National Aerospace Plane, dubbed PTAPS, for Personal Trans-Atmospheric Protection System. FY 1989 Planned Program: Work on prototype tactical sub-systems initiated above will provide products for man-rating and flight demonstration. Tri-service requirements will be addressed during design and test phases to assure DOD commonality. Results will be reviewed to determine if integration of these features with the core Tactical Life System System requires additional work, or if the resulting ensemble is recommended for full-scale development. The Advanced High Altitude Protection System development contract will be awarded. Liason with Project 2992 and the National Aerospace Plane program will continue, to ensure timely activation of Personal Trans-Atmospheric Protection System options as appropriate.

D. (U) Project: 2868, Crew Escape Technologies (CREST). The CREST project integrates advanced subsytems into an ejection seat capable of protecting aircrew throughout the performance envelope of modern aircraft. The goal is to reduce fatalities and major injury rates in emergency ejections at all speeds between 0 and 700 knots, especially with adverse aircraft attitude and non-level flight at low altitude. While approximately doubling the current safe ejection envelope, CREST also will provide significant improvements in reliability, maintainability and capability for logistics supportability over current ejection seat technologies. The CREST program will demonstrate an escape capability for aircraft of the future while developing many technologies which also will permit upgrading of existing ejection seats. FY 1987 Accomplishments: Critical design and fabrication of advanced subsystem technologies was the focus of this year. Subsystem testing began in areas such as windblast protection, restraints, and the rocket motor. Wind tunnel testing to determine the seat aerodynamic characteristics was completed. The seat flight controller/sequencer hardware subcontractor failed to complete the design and fabrication of this subsystem, and as a result, the effort was turned over to a new subcontractor. Because of this and greater-than-anticipated engineering effort required to integrate subsystems, the CREST program is experiencing a schedule slip and cost overrun. A new cost proposal and program schedule were submitted to the Air Force. Prototype advanced manikins for use in rocket sled testing of CREST were delivered to the Air Force; conformance and performance testing of the manikins began. Design and fabrication of the advanced rocket sled for ejection testing was completed. FY 1988 Program: Subsystem testing and integration will be accomplished. Special emphasis will be placed on subsystem integration to increase confidence in new subsystem technologies and reduce the risk of the final phase (system demonstration) of the program. Flight controller design, fabrication and testing will be the primary driver in the integration effort. Delivery of the production models of the advanced manikin will begin. Delivery of the advanced rocket sled will be early in the year, followed by performance testing. FY 1989 Planned Program: A Critical Design Review will take place, marking the end of Phase IIB and the

beginning of Phase III. System demonstration tests will begin in the form of ejections from the advanced rocket sled to demonstrate ejection seat performance through a range of operational and projected ejection environments. Parallel computational simulations will be conducted to validate and integrate actual test data. Efforts to Complete: Phase III demonstration tests will be completed. As tests on the CREST seat verify its performance in environments three times the speed of sound, and confirm its suitability for transition to full-scale development, follow-on investigations will begin to support hypersonic ejection systems to meet the requirements of future manned aerospace vehicles. The transition products for the current CREST effort will include complete design specifications and a tailored logistics support analysis appropriate to advanced development. Transition agreements exist with the Life Support System Program Office (SPO), Advanced Tactical Fighter SPO, and US Navy. Additionally, test fixtures and instruments used in CREST testing will be made available to other developmental efforts in ejection and impact technology.

E. (U) Project: 2992, Space Crew Enhancement (SPACE). The SPACE project develops specialized crew protection systems and accomplishes man-machine integration needed to exploit or enhance man's ability to support military missions from space. To ensure effectiveness of military space-related systems, whether ground-based or space-based, human engineering concepts must be employed to assure optimum performance. This program will help define man's potential roles in military space systems as well as quantify the trade-offs of manned versus unmanned space systems to support such tasks as logistics and surveillance. It will demonstrate concepts and technologies necessary to ensure life support, crew performance and crew protection in the complex and potentially hazardous environment unique to military space systems. An area of specific near-term interest includes technologies to support the development of transatmospheric vehicles, which are likely to have different launch and egress response times, flight durations, acceleration profiles, performance characteristics, operator workload and task requirements than the space shuttle. FY 1987 Accomplishments: The program funded efforts to define human performance and design criteria applicable to hypervelocity and transatmospheric type vehicles. Prototype pressure suit modifications were developed and initial testing was conducted. Coordination with NASA on heads-up displays established an advisory role for the program. Extensive coordination continued with the Air Force Geophysics Laboratory on their modeling capability for differential charge buildup on space suits in the polar latitudes. The visual acquisition system (SPADVOS - Space-borne Direct View Optical System) has been deemed the number one priority by the Department of Defense's Military Man-in-Space Experiment Prioritization Panel. The SPADVOS system has gone through extensive design and modification, and has been successfully tested on an airborne platform. User requirements and technology transition were coordinated with Space Command, Space Division and the National Aerospace Plane Program Office. FY 1988 Program: Transition products from initial space suit modification efforts will be evaluated as concept studies are conducted for further modifications. Airborne tests of the visual acquisition and tracking system will continue. Work will begin on military-unique features of helmet-mounted displays for presenting operational and logistics data to spacesuited crewmembers during extravehicular activity. FY 1989 Planned Program: Demonstration of the visual acquisition tracking system will lead to an evaluation of its utility in space operations. The program will continue to develop specifications and subsystems for military space suits, to include provisions for shorter egress times, improved logistics supportability, advanced in-helmet

displays, and increased radiation protection. Efforts will also continue to incorporate crew station design criteria and advanced control/display technologies into required military-unique systems. Transatmospheric pressure suit requirements will be monitored to permit their possible integration into a parallel (Project 2830) pressure suit development contract. A contract option for a variant called PTAPS (Personal Transatmospheric Protection System) will be activated as required. In the out years, specific applications of pressure suit advance technologies will be applied to human engineering concepts used in transatmospheric vehicles. Orbital flight tests of SPADVOS, and possible man-rating of PTAPS, will be conducted to establish the validity of the technologies. Efforts will also continue to coordinate work on gyrostabilization platforms and computer generated targeting systems. Efforts to ensure clear definitions of user requirements and well-coordinated technology transitions will be ongoing.

F. (U) Project: 3256, Advanced Strategic Aerospace Crew Systems (ADSACS). This project was approved and initiated as an Air Force new start for FY 1987, but with specific resources not initially identified until FY 1989. It addresses the crew systems needed for strategic aircraft strikes against relocatable targets. No aircrew has ever been required to locate, acquire and strike strategic relocatable targets (SRTs); and no man-machine system or human factors analysis of system requirements exists to ensure mission success. Through analysis and ground-based demonstrations with man-in-the-loop simulation, this project will define the crew structure and functional requirements for existing and future aircraft to accomplish this mission. Major tasks include determining crew capabilities, quantifying sensor display performance requirements, integrating real-time adaptive strategic force management, ascertaining target acquisition probabilities in the face of deception and denial measures, and demonstrating appropriate crew stations to optimize performance. FY 1987 Accomplishments: A program manager was assigned and tracking of exploratory development technology and programmatics continued. Human-centered SRT mission scenarios and methods for analyzing them for allocation of functions were generated during exploratory development.. Coordination with Strategic Air Command and full-scale engineering development program offices continued. Program direction goals and milestones were developed and issued. This project is specifically mentioned in Strategic Air Command SAC SON 001-85, Strategic Relocatable Target Capability as supporting that initiative. This project was one of fourteen programs identified in AFSC Strategic Relocatable Target mid- and far-term technology road maps. FY 1988 Program: Details of the acquisition plan will be developed for approval and contract preparation will be initiated. Coordination with users and parallel avionics development programs will converge into a transition plan. Agreements will be arranged for matrix technical support and technology transition from exploratory development. FY 1989 Planned Program: The acquisition strategy will be initiated based on funding. Mission scenarios generated in exploratory development will be used as a basis for developing detailed SRT mission descriptions at which time analyses will be performed using a computer mission decomposition tool. Execution of SRT missions against advanced threats will be analyzed to establish aircrew information requirements, task allocations, automation requirements, technology applications and timeline requirements. Analysis of function allocation requirements for each crew station will be performed to provide information for part-task and

part-mission simulation studies. This will allow development of a conceptual crew station design to be initiated. Close interaction with SAC, Aeronautical Systems Division and other agencies during the analyses and the simulations will continue.

G. (U) Project: 3257, Virtual Image Cockpit (VIC). This effort was approved as an Air Force new start in FY 1987 but without specific resources identified until FY 1988. VIC develops and demonstrates maturing concepts for enhancing the man-machine interface in aerospace systems, specifically the high-performance, high-stress environment of advanced fighter aircraft. The effort provides technologies for innovative visual, aural and tactile controls and displays using unique "virtual world" concepts that effectively surround the pilot with easily assimilated information to maximize situational awareness. Natural body movements, voice and multiple sensory inputs are integrated to give the pilot a coherent picture of his environment and mission status while performing complex control functions. Computer-assisted functions act to decrease pilot workload in addition to monitoring the pilot psychophysical state so that decrements in pilot performance can be compensated. FY 1987 Accomplishments: A program manager was assigned and the ground work for an aquisition strategy initiated. Monitoring of exploratory development ground-based demonstrations and analysis continued. FY 1988 Program: The acquisition strategy and Program Management Plan will be submitted for approval. A currently marketed all-aspect heads-up display (HUD) will be acquired and performance tested so as to identify technical improvements which must be achieved to meet operational performance requirements. Development will begin on head-aimed fire control components of an all-aspect HUD that will give the pilot control and display information wherever his eyes are directed. Integration will begin on display and control components leading to the development of both monocular and binocular all-aspect HUDs. Transition of the current night vision goggle HUD to the Air Force Logistics Command will continue. Limited development will begin on an upgraded version of the night vision goggle HUD. The purpose of this development is to provide the user with a well balanced, a correctly positioned center of gravity, night vision goggle capability in a helmet which is compatible with a fast moving, ejection capable aircraft. FY 1989 Planned Program: Development of both the monocular and binocular all-aspect HUD will continue. Developmental test and evaluation will be planned. User commands will be coordinated with to identify test requirements. The responsible test organization will be identified. The test evaluation master plan for a non major weapon system will be written and submitted for approval. Night vision goggle HUD transition to AFLC for using command procurement will be completed. Development of the improved night vision goggle HUD will continue with a head positioning sensor to provide aircrews all-aspect target cueing and designation capabilities at night. Request for proposals and source selection will begin on the concept and definition study aimed at identifying technical requirements and operational concepts of a virtual image cockpit. Begin development of long lead item components for out year efforts; miniature color displays, three-dimensional auditory localization and eye control.

H. (U) Project: 3281, Human Centered Technology for Command, Control and Communications ($C^3$). This effort was approved and initiated as an Air Force new start for FY 1987, but with specific resources not identified until FY 1989. It develops and demonstrates technologies to enhance human operator effectiveness in national, strategic and tactical

$C^3$ systems. It evaluates and specifies crew systems for effective battle awareness and management of military forces in all phases of conflict, assessing mission performance through realistic $C^3$ mission environment simulations. The focus of this effort is to capitalize on tri-service exploratory development capabilities to enhance $C^3$ network effectiveness by improving operator performance. Crew workstations are defined which make best use of the human operator in automated command and control networks. Training procedures and systems are defined for effective team decision making and use of $C^3$ systems with decision aids. FY 1987 Accomplishments: A formalized structure to track interlaboratory technical progress was defined. Requirements for improved $C^3$ operator performance were reviewed. Participation in tri-service, Joint Directors of Laboratories panel discussions have been initiated to explore interdependent development of $C^3$ operator technologies. FY 1988 Program: Through interlaboratory and tri-service coordination, a program plan will be prepared to address development and evaluation of improved $C^3$ operator technologies. Will continue to leverage resources within the individual service laboratories with tri-service coordination to plan for a set of interdependent, service conducted analyses and evaluations. Coordination through the Joint Directors of Laboratories Panel structure will continue. FY 1989 Planned Program: The development of $C^3$ human operator performance enhancement will be implemented in conjunction with parallel service sponsored development of $C^3$ networks and decision aiding technologies. Specific efforts will address measures of operator performance in large scale $C^3$ tactical network simulstions and operator impact on strategic force management. This project will focus on the human performance elements within $C^3$ systems development.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable for funded agreements directly with Air Force, although some subcontractors are currently in the United Kingdom and Canada. The overall program element maintains international coordination through the Air Standardization Coordinating Committee, NATO Advisory Groups for Aerospace Research and Development (AGARD), and specific Data Exchange Agreements with various countries.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603245F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Advanced Flight Technology Integration (AFTI)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 28,859 | 22,352 | 23,980 | Continuing | N/A |
| 2061 | Attack Technology | 1,675 | 600 | 5,466 | Continuing | N/A |
| 2568 | Mission Adaptive Wing | 2,100 | 2,244 | 1,000 | 0 | 34,172 |
| 2682 | Short Takeoff and Landing/Maneuver Technology Demonstrator | 14,603 | 8,608 | 9,854 | Continuing | N/A |
| 2979 | Reliability and Maintainability for Flight Technology Integration | 1,658 | 2,400 | 3,460 | Continuing | N/A |
| 3391 | X-29 Advanced Technology Demonstrator | 8,500 | 8,500 | 4,200 | 500 | 21,700 |
| 3417 | Boost Glide Vehicle Demonstration | 323 | 0 | 0 | 0 | 323 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology flight validates technologies for modifications to current aircraft and development of future vehicles. This is accomplished through system level flight testing of fully integrated sets of synergistic technologies under simulated mission conditions. This testbed approach gives early indications of the benefits that integrated technologies can give future production and modified existing systems, at one-tenth the full-scale development cost. Emphasizing technology at a system level (proven under operational conditions) ensures that a base of proven technology is available to support development of the next generation of flight vehicles as well as derivatives of existing flight vehicle systems. These data enable the Air Force to concentrate on design options during full-scale development efforts. This PE integrates and flight validates the technology provided by Aerospace Vehicle Technology (PE 0603205F) as well as other PEs and performs studies/analyses for potential mission areas. The most pressing needs currently being addressed are technologies for integrated test demonstrations of low cost reliable low maintenance air combat aircraft with increased tactical survivability. In FY 1988 the programs to validate these needed capabilities Integrated Control/Avionics for Air Superiority, the Short Takeoff and Landing/Maneuver Technology Demonstrator Mission Adaptive Wing, the X-29 Advanced Technology Demonstrator, and Self-Repairing Flight Control Systems.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 25,102 | 29,734 | 32,904 | Continuing | N/A |

EXPLANATION: (U) $3.8 million for the X-29 was reprogramed into this PE bringing the total to $28.859 million for FY 1987. FY 1988 differences are due to FY 1988 Congressional Reductions. Congressional direction cut FY 1988 Boost Glide Vehicle (BGV) by $7.4 million and terminated the BGV program. The FY 1989 reduction accommodates

reductions in Air Force Total Obligation Authority and reflects the termination of the Boost Glide Vehicle (BGV) program.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 0603205F, Aerospace Vehicle Technology provides component technologies that are integrated and flight tested in PE 0603245F. PE 0603253F, Advanced Avionic Integration, also provides basic avionics algorithms used to develop flight control software PE 0603211F, (Aerospace Structures and Materials) and NASA provide technologies and funding for integration and flight validation on Advanced Fighter Technology Integration (AFTI) test vehicles. Navy, Air Force, and NASA efforts are coordinated by the Aeronautical Flight Technology/Research Activities Coordinating Group and the Office of the Secretary of Defense. Memoranda of agreements between all three Services and NASA assure maximum transition of technology and no duplication of effort. The X-29 program is jointly funded with NASA and DARPA.

6. (U) WORK PERFORMED BY: This program element is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Contractors are General Dynamics Corporation, Ft. Worth, TX (2061); The Boeing Company, Seattle, WA (2568), McDonnell-Douglas Aircraft Corp of St. Louis, MO (2061, 2682), and Grumman Aircraft Corporation, Bethpage, NY (3391). There are seven additional contracts with a total contract value of $6.4 million. Flight testing will be performed by Dryden Flight Research Facility and the Air Force Flight Test Center at Edwards AFB, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2061, Attack Technology. The Integrated Control and Avionics for Air Superiority (ICAAS) program emphasizes the need for functional integration between the primary elements of a fighter aircraft weapon system, including: (1) target/threat sensors, (2) fire control, (3) flight control, (4) weapons, and (5) pilot interface. The program addresses the engagement phase of the air-to-air mission integrating improvements in pilot situation awareness beyond-visual-range (BVP) attack, effective transition to within-visual-range attack, threat missile evasion, and cooperative tasking (internetting) among friendly aircraft. Decision and control aids will be developed to help the pilot attack his targets. These aids will maximize weapon launch opportunities and minimize exposure to threats. Guidance information will be presented to the pilot for avoiding/evading threat missiles. Integrated information presented in the cockpit will enhance pilot situation awareness and allow the pilot to make better decisions. The ICAAS contractor will incorporate software from the associated Air-to-Air Attack Management (AAAM) program, in PE 0603203F, which will develop algorithms that perform target detection, track, and identification functions from onboard and internetted fighter sensors. Radar tracks of the enemy will be used to allocate target assignment to each of the friendly aircraft and compute feasible missile launch opportunities. Decision aids provide the pilot with recommended target priorities and engagement data. Fire control software will enable missile launch against multiple BVR threats using active or passive sensor modes. AAAM software will be subjected to piloted simulation evaluation and transitioned to Integrated Control Avionics for Air Superiority (ICAAS) for system integration. Integration of offensive and defensive algorithms is expected to yield synergistic performance improvements. For example, attack will be executed with defensive contingencies in mind, and defense will be implemented so as to not abandon an offensive posture.

Information generated from onboard software will help the pilot handle simultaneous events which occur when engaging multiple targets. Ada, a DOD standard computer language, will be used for all software development to assure maximum commonality and transferability to future and existing systems. Contracts were awarded in FY 1987 for development of Air-to-Air Attack Management and Integration of Control Avionics for Air Superiority (ICAAS) software, and pilot, vehicle interface design. During FY 1988 this project will define a concept for a fighter aircraft subsystem that improves our ability to fight in air-to-air combat. The process of defining the concept includes the identification of tasks the system must carry out, a preliminary determination of the hardware needed to implement the system, and an estimate of the mathematical equations and algorithms to be developed that will permit aircraft and sensor data processing and, where necessary, task automation. The FY 1988 activity will concentrate on the conceptual definition of these functions by specifying the mathematical equations and algorithms needed, the software needed to mechanize the algorithms, the hardware needed to implement the total system, and the aircraft modification required to carry out flight testing of the final design later in the program. During FY 1989, work will center primarily around the development of software and preparation of specifications for both simulation and aircraft hardware and computer requirements. This will provide ground based software and hardware to screen system concepts prior to flight testing.

B. (U) Project: 2568, Mission Adaptive Wing (MAW). In conjunction with NASA, this program is flight validating the aerodynamic payoff of integrating variable camber (wing shape) into a smooth skin wing (no flaps or ailerons). Optimization of the wing shape during flight improves range, turning rate, and ride quality. Compared to a standard F-111, an aircraft with a MAW would reduce fuel consumption by 30 percent. In FY 1987 the MAW was flight tested in the manual mode. The wing performed better than expected. The drag was lower and the lift higher than predicted. The automatic control system was installed and flight testing of the MAW in the automatic mode was started. Flight testing of the MAW in the automatic mode will continue through FY 1988. In FY 1989 the MAW program will be completed and a technical analysis of the available flight test data will be released for application to the Advanced Tactical Fighter and other vehicles. A joint NASA/Air Force Hybrid Laminar Flow (HLF) wing system flight experiment will be conducted to evaluate the extent of the laminar boundary layer that can be maintained using leading edge suction applicable to derivative transport aircraft, advanced technology transports and special operations aircraft cruising at subsonic speeds. During FY 1989, this project will develop the flight test plan and integrate the hybrid laminar flow system into a Boeing 757 aircraft for initial flight testing.

C. (U) Project: 2979, Reliability/Maintainability for Flight Technology Integration. Self-Repairing Flight Control System (SRFCS) consists of reconfigurable flight controls and artificially intelligent maintenance diagnostics. SRFCS will cut flight control system maintenance to one-seventh of what it is today, increasing aircraft availability and warfighting capability. Taking advantage of the inherent redundancy in the suite of flight control surfaces (ailerons, stabilators, etc.) rather than requiring redundant surface control equipment (servoactuators, hydraulics, etc.), SRFCS will reduce the control system actuator complexity by up to 75 percent. When a component (actuation control) fails, the SRFCS will automatically reconfigure the remaining flight control system components in order to maintain safe, although gracefully degraded, flight. Automatic reconfiguration is estimated to be four times safer than today's system. To aid flight line maintenance, the defective component is identified by the Artificial Intelligence diagnostic system, along with the component failure effects on the aircraft and impact on mission/safety requirements. In combat, the system will reconfigure around battle damage and notify the pilot of the

remaining flight control capability. The Self-Repairing Flight Control System (SRFCS) will attempt to restore full control and monitor any further damage. In absence of full control, residual control authority will be maximized to allow return to base, or stabilize the aircraft long enough for a successful crew escape. In FY 1987, the engineering design for reconfiguring from a single surface failure was developed. Intermediate results for designing a reconfigurable flight control system were obtained. In FY 1988, the design of an onboard expert diagnostic system will be completed and placed in early flight test. The hardware and software development for flight testing will be underway. In FY 1989 a trade study of reconfigurable flight control system design for the next generation of aircraft will be completed, integrating the results of the flight testing. The initial flight tests for a single surface impairment will be conducted. A complete ground-based sensitivity trade study and interaction of an example automatic mode in flight test will be completed. Design criteria for developing the SRFCS for the next generation fighter will be delivered. The engineering design for a complete multi-axis SRFCS flight test will be initiated.

D. (U) Project: 3391, X-29 Advanced Technology Demonstrator. This project develops, integrates, and flight validates advanced aerodynamic, structural, and flight-control technologies of a forward swept wing aircraft that will provide design options for future military aircraft. Technologies include an aeroelastically tailored forward swept wing using composite wing skins, discrete variable wing camber, relaxed static stability, and digital fly-by-wire flight controls with full-authority close-coupled canards and three-surface pitch control. The Air Force is extending the work begun under a Defense Advanced Research Projects Agency (DARPA) funded and managed program that concluded in FY 1986. This project will transition these technologies to advanced development in order to evaluate their military utility and investigate high angle-of-attack (AOA) flight characteristics of the forward swept wing on the X-29 aircraft In FY 1987 flight testing of the X-29-1 was conducted to obtain detailed research data on performance, loads/buffet, and military utility handling qualities. Modifications to the X-29-2 (spin chute addition and instrumentation upgrade) for high AOA flight testing was started. X-29-1 flight testing will continue in FY 1988. Additionally, X-29-2 flight control system modifications will be made to improve basic airplane flying qualities and to expand these into the high AOA flight regime. Spin chute and instrumentation upgrades will be completed on X-29-2. In FY 1989 ground tests will be conducted to check out all aircraft systems on X-29-2 and high AOA flight testing will be conducted. Additionally, extensive computer simulation of flight controls will be conducted. Flight testing will continue through FY 1989. Funding requirements are based on both program office analysis and detailed contractor estimates (Cost categories III, Budgeting IV and, Planning).

E. (U) Project: 2682, Short Takeoff and Landing Maneuver Technology Demonstrator (STOL/MTD). This project integrates and flight tests on a modified F-15, two-dimensional thrust vectoring/reversing nozzles, flight/nozzle controls, aircraft braking, and pilot/vehicle interface technology developed by PE 0603205F. These technologies will produce an aircraft that can: (a) be controlled at any altitude airspeed or attitude by vectoring the thrust-system thereby outperforming any solely aerodynamically configured aircraft (b) use vectored propulsion in flight to reduce fuel consumption caused by aerodynamic drag thereby increasing range; (c) control percent of thrust required while maintaining constant engine speed, providing in-flight thrust reversing and improved energy management during combat, takeoff/landing and cruise; (d) takeoff and land on an icy runway, only 1500 feet long by 50 feet wide, in up to a 30-knot crosswind without the aid of ground support such as an instrument landing system. This circumvents runway denial tactics and/or allows dispersion to austere bases. Note: Funding for subcomponents and individual technologies is

provided by PE 0603205F while PE 0603245F provides funding for systemwide integration and flight test. In FY 1987 modification of a test-configuration F-15 began. Integration of the flight/propulsion control software was simulated. Control laws (including nozzle controls) using advanced control system synthesis techniques were developed, providing new ways for a pilot to fly an airplane with the unique capabilities of the Short Takeoff and Landing/Maneuver Technology Demonstrator (STOL/MTD). Display formats were also developed, with emphasis on integration with pilot tasking in order to lower workload. Improved landing gear capability was developed that will allow operation on repaired runways with rough surfaces that would prohibit operation with current equipment. In FY 1988 all design aspects of the demonstrator will be validated by ground test. Aircraft modification will be completed with standard F-100-200 engines and axi-symmetric nozzles. A limited flight test program will be accomplished to check out the aircraft and generate baseline data prior to installation of the two degree of freedom (2-D) nozzle. The 2-D nozzle ground test program for flight clearance will be initiated. In FY 1989 the modified F-15 aircraft will have completed ground certification and be ready for its first flight with 2-D nozzles by Feb 1989. This includes: (1) completion of ground testing of the engines equipped with two-dimensional thrust vectoring and reversing nozzles, thrust stand, wind tunnel, and accelerate mission testing; (2) completion of aircraft modifications to incorporate engines and new nozzles, flight control and nozzle controllers, plus modified central computer, modified landing gear, upgraded cockpit displays, canards and new technology actuators; (3) inspection for Air Force acceptance of the STOL/MTD aircraft; (4) performance of hardware-in-the-loop simulations using actual flight control computers to verify hardware/software integrity; (5) completion of on-aircraft ground testing to verify functional integration of the new technology components; and (6) accomplish reviews necessary for flight clearance of the aircraft. The validation and modification, if necessary, of the pilot/vehicle interface and flight/nozzle control software will be conducted to demonstrate improved rough/soft field landing gear capability for the F-15 and to demonstrate a Short Takeoff and Landing (STOL) capability that is compatible with high performance fighter designs. During FY 1989 the program will: (1) complete the flight testing to quantify the benefit of the control system in all mission phases; (2) validate the application of modern control theory and multiple input/multiple output control systems to enable STOL performance for high speed fighters; (3) demonstrate the feasibility of using on-board sensors for precise landing in low visibility and adverse weather as a routine operational capability; (4) quantify flying qualities test results and initiate any necessary changes to government flying qualities specification, and (5) prepare final program documentation and transition the technology to industry and appropriate government agencies. This includes data on specific mission profiles, i.e., air-to-air, training, ferry, etc., to provide first order reliability and maintainability data on integrated flight propulsion controls. Final reports documenting the test results will be written. The costs for FY 1989 are based on actual contract requirements (Category II, Mature) and Air Force Flight Test Center Statement of Capability. The Integrated Control Program (ICON) will begin design of an integrated flight nozzle, engine, and inlet control system which provides the reliability critical for application of an integrated flight propulsion control system in an operational aircraft.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603250F
DOD Mission Area: 551 - Electronics & Physical Sciences (ATD)
Title: Lincoln Laboratory
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimated | FY 1989 Estimated | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 26,500 | 22,000 | 25,132 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Lincoln Laboratory Program is a high technology research and development effort conducted through the provisions of a cost reimbursement contract with Massachusetts Institute of Technology. Lincoln Laboratory is operated as a Federal Contract Research Center administered by the Department of Defense. From this technology base, Lincoln Laboratory engages in advanced research and technology demonstrations in the areas of military satellite communications, space radar technology, space-based visible surveillance, deep-space surveillance, and tactical battlefield surveillance. Lincoln Laboratory also provides technical advance and consultation to the military services and defense agencies. This is a Science and Technology program.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 18,841 | 24,760 | 26,655 | Continuing | N/A |

EXPLANATION: (U) FY 1987: Reprogramming of $7,659 was necessary to fund 20 members of the Members of the Technical Staff (MTS).

FY 1988: Reduced by Congress to 22,000. Reprogramming action in progress at Headquarters. Air Force Systems Command to restore funding to 26,000. This level of funding supports approximately 120 MTS.

FY 1989: Reduced by 3,020 and supports approximately 118 MTS.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Many of the efforts funded by this program element are carried out in conjunction with one or more of the following: Milstar, PE 0303250F; C3 Advance Development, PE 0603789F; Command, Control, and Communications, PE 0602702F; SPACETRACK, PE 0102424F; Space Surveillance Technology, PE 0603428F; Communications Security, PE 0303401F; Defense Research Sciences, PE 0601102F; Restructurable Very Large Scale Integration, PE 0601101E (Defense Advanced Research Projects Agency (DARPA)); Wafer-Scale Integration, PE 0602301E (DARPA); Laser Imaging Technology Work Package Directive 17.1 (Strategic Defense Initiative Organization); and Advanced Communications

Technology Satellite National Aeronautics and Space Administration.

6. (U) WORK PERFORMED BY: Lincoln Laboratory, Lexington, MA, is a special laboratory of the Massachusetts Institute of Technology under contract with the Air Force and is designated a Federal Contract Research Center. General policy and program guidance are provided by the Lincoln Laboratory Joint Advisory Committee in accordance with the provisions of the Department of Defense Plan for Administration of Lincoln Laboratory, dated 27 May 1975. The Lincoln Laboratory contract is administered by the Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0603250F, Lincoln Laboratory.

A. (U) Project Description: Lincoln Laboratory was established in 1951 by the Air Force with participation by other agencies of the Department of Defense. The mission is to conduct research and development pertinent to national defense. The Lincoln program extends from fundamental investigations in science through the development of electronic devices and components to the design, development, and field demonstration of conceptual models containing the new technology. Lincoln's research activity encompasses work in military satellite communications, space radar technology, space-based visible surveillance, deep space surveillance, and tactical battlefield surveillance (radar and emitter location). Lincoln also provides technical advice and consultation to the military services and defense agencies.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: LASER COMMUNICATIONS (LASERCOM) TECHNOLOGY: Developed in-house prototype of Lasercom flight package as part of plan to integrate onto the National Aeronautics & Space Administration (NASA) Advanced Communications Technology Satellite (ACTS); funding constraints limited actual procurement activities and resulted in a proposed restructuring of this program; the object has shifted from a flight demonstration on ACTS to a crosslink technology "on-the-shelf" program at acceptable risk within the lab. EXTREMELY HIGH FREQUENCY (EHF) SATELLITE COMMUNICATIONS TECHNOLOGY: Completed development of prototype man-portable Milstar-compatible terminal and transitioned one system to the Army for testing with in-orbit Fleet Satellite EHF Package (FEP). MILITARY SATELLITE COMMUNICATIONS SYSTEM ENGINEERING: Continue contribution to Satellite Data Link Standards program and technology transfers to Milstar contractors. DIGITAL INTEGRATED CIRCUITS PROGRAM: Developed 4-inch wafer-scale integrated circuits with reduced-size diode links; designed and fabricated million-plus transistor system for image-processing applications; under the VLSI restructurable technology, reduced laser pulse length by more than 10 times - shorter zap times do less damage; demonstrated link restructuring for rapid turnaround custom logic. SOLID STATE TECHNOLOGY: Developed gallium arsenide (GaAs) permeable-based transistors operated in EHF discrete and monolithic amplifiers and wide-bandwidth sample and hold circuits; continue to explore high-frequency field effect transistors to exploit the high frequency velocities in indium

phosphide and gallium-indium arsenide; continued development of enhanced and new vapor deposition technologies for circuit fabrication for electro-optical devices and larger scale monolithic diode laser arrays; designed, fabricated & tested superconductor Josephson digital circuit which provides a binary representation of the address at any of seven inputs; improved SAW/FET transversal filters with 100 MHz of programmable bandwidth with decreased insertion loss. SPACE-BASED RADAR TECHNOLOGY: Continue installation of near-field test range; demonstrated 50 dB sidelobe nulling width for channel receiver and low-sidelobe antenna; fabricated systolic arrays for jamming/clutter processing; developed high-quality low noise amplifiers and fiber optics for transmit modules; developed wideband nulling algorithms; continue exploration of cross-section target detection techniques. SPACE-BASED/AIRBORNE RADAR: Infrared Airborne Radar began testing; continued development on a neural network processor for the radar. TACTICAL BATTLEFIELD SURVEILLANCE: Continued development of compact, high-speed signal and data processor for the infrared airborne radar demonstration as part of a mini remotely piloted vehicle program; completion of full-scale flight tests of the advanced adaptive array emitter location system.

(2) (U) FY 1988 Program: The basic thrusts in satellite communications will be continued. Execute the restructured Lasercom program. System engineering efforts will focus on Defense Satellite Communications System-III follow-on wideband applications. Development of wafer-scale integratred circuits for processing focal plane array signals for electro-optic surveillance applications will begin. Fabrication and testing of radiation-hard wafer-scale integrated circuits based on Lincoln developed silicon-on-insulator and rad-hard gate technologies will be initiated. Development of extremely high frequency (EHF) power permeable-base transistors (PBTs) and monolithic integrated circuits incorporating PBTs will begin. Development of high-frequency indium phosphide and gallium-idium arsenide field-effect transistors will begin. Demonstration of high-speed optical interconnect techniques using monolithic gallium-arsenide (GaAs)-on-silicon structures will proceed. Space radar efforts will be concentrated on completion of near-field test range, and continuation of advanced adaptive nulling demonstrations. The development of various charge-coupled device (CCD) imagers will continue, with the technology demonstrated using experimental electro-optical targets and backgrounds. Target detection and false alarm statistics will be developed. Multi-dimensional data will be tested for target recognition on an off-line neural learning machine. Development of a real-time processor for in-flight testing will be initiated. Wafer-scale chips and neural network processors on silicon will be tested. Free-flight tests of the remotely piloted vehicle radar system will take place. An advanced version of the signal-data processor should realize a capacity of 150 million operations per second in a 30-lb, 1 cubic-ft package. Refined emitter location algorithms will be developed, based on the results of the flight program. This is a technology development program and planning cost estimates are based on engineering judgments and comparison with similar technology development efforts. Expand recent demonstration in superconduction Josephson digital circuit to other digital devices and continue development of superconductive thin films.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Demonstration of the wafer-scale focal plane processor for electro-optic surveillance applications will begin. Development of a radiation-hard focal-plane processor will be initiated. Extremely high frequency (EHF) power permeable-based transistors (PBTs) will be improved and fabrication of more complex monolithic integrated circuits incorporating PBTs will begin. Sensitivity of CCD

imagers will be improved by introducing avalanche gain in the CCDs to overcome the noise of the charge-sensing circuit. Monolithic integration of very-large-scale-integration silicon circuits and high-speed gallium-arsenide (GaAs) circuits will be undertaken. Advanced space radar transmit/receive module component development will be explored. Development of fiber-optic devices for light-weight phased-array power distribution and wafer-scale integration of systolic array configurations for high throughput signal processing requirements will also begin. New medium-wave infrared detector arrays to provide for high throughput signal processing requirements will also begin. New medium-wave infrared detector arrays to provide improved performance will be developed. Technology demonstrations using experimental electro-optical sensors in laboratory and field-site testing will be pursued. Flight testing of the infrared airborne radar with an on-board real-time processor will be undertaken. Testing of autonomous acquisition and identification techniques against a variety of tactical targets for aircraft ground attack and smart weapon application will proceed. Improved radar capabilities (doppler beam sharpening) will be added to the remotely piloted vehicle radar. Development of new emitter location algorithms that can cope with advanced signal formats will be initiated. This is a technology development program and planning cost estimates are based on engineering judgments and comparison with similar technology development efforts. Continue development of superconductive thin films and expand recent demonstrations using superconductive digital circuits to other digital devices. Execute restructured Lasercom Program to provide "on-the-shelf" optical crosslink technology at an acceptable risk by building on the original design of the Laser Intersatellite Transmission Experiment (LITE). Develop engineering models which will serve as a point-of-departure for follow-on program. Qualify for operational use high-risk optical technologies and transition them to industry.

(4) (U) <u>Program to Completion:</u> This is a continuing program.

C. (U) <u>Major Milestones</u>: Not applicable.

9. (U) <u>COOPERATIVE AGREEMENTS</u>: Not applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603253F Title: Advanced Avionics Integration
DOD Mission Area: 551 - Electronic and Physical Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 5,555 | 2,992 | 14,028 | Continuing | N/A |
| 666A | Advanced Reference Systems Development | 1,749 | 1,800 | 1,700 | Continuing | N/A |
| 2345 | Airborne Imagery Transmission System | 2,012 | Transfer to PE 63203F | | N/A | N/A |
| 2735 | Advanced Systems Avionics Applications | 1,175 | 1,192 | 1,195 | Continuing | N/A |
| 2746 | Low Probability of Intercept Communications | 619 | Transfer to PE 63203F | | N/A | N/A |
| 2733 | Advanced Reconnaisance/ Strike Radar | 0* | 0 | 11,133 | Continuing | N/A |

*Funding in PE 63203F

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is the tech base from which the integrated avionics suite of the Advanced Tactical Fighter (ATF) evolved. Digital Avionics Integrated Systems (DAIS), high speed data bus, Common Signal Processor (CSP), VHSIC-1750A Data Processor, Integrated Communication, Navigation, Identification Avionics (ICNIA) and Pave Pillar all started in this element. It is now furthering the next advances in integration through sensor fusion, artificial intelligence (AI) and Ada. Functional areas being focused on are: reconnaissance/strike radars, navigation/reference system, cockpit displays, and fault tolerant processing networks and software.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 3,891 | 16,676 | 15,040 | Continuing | N/A |

EXPLANATION (U): FY 1987 increase due to below threshold reprogramming. FY 1988 reduction due to Congressional cut, putting Project 2733 at risk to cancellation. FY 1989 reduction due to DOD reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 62204F, Project 2003, Avionics System Design Technology; Project 7662, All Weather Recce/Strike Avionics; and Project 6095 Inertial Reference and Guidance provide supporting technology for this program. PE 63226F, DOD Common Programming Language Advanced Development and PE 63728F, Advanced Computer Technology will provide Ada support software products for use by this program for application to avionics-related software developments. Close coordination with the Defense Advanced Research Projects Agency sponsored Pilot's Association Program is needed so that expert systems technology can be used to reduce crew work load. Close coordination between this program and PE 63601F, Project 670A, Ordnance Technology, will be maintained to insure successful implementation of MIL-STD-1760, Aircraft-to-Stores Interface. Close coordination with PE 63231F, Project 2829, Cockpit Automation Technology, will be maintained to insure appropriate use of new automation control and display concepts. PE 62204F Aerospace Avionics provides supporting exploratory development of solid state active aperture arrays for high reliability airborne radars to Project 2733. Project 2733 transitions advanced radar technology to PE 64201F Aircraft Avionics Equipment Development.

6. (U) WORK PERFORMED BY: Current efforts are being performed by Westinghouse Electric Company, Baltimore, MD; Texas Instruments, Dallas TX; Rockwell International, Collins Radio Division, Cedar Rapids IA; Hughes Aircraft Co, Los Angeles CA; Rockwell International, Anaheim CA. The in-house organizations responsible for the program are the Mission Avionics and System Avionics Division, Avionics Laboratory, Wright-Patterson AFB OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 666A, Advanced Reference Systems Development. This project will provide sensors, integration techniques and systems to improve the accuracy and availability of navigation and reference information for future weapon delivery systems. The objective of the technology developments will be to improve the availability and capabilities of tactical aircraft, strategic aircraft and cruise missiles to operate in an autonomous mode for global all-weather strikes. Major technology thrusts are in the areas of inertial and radio navigation components and systems integration with emphasis on increased performance, reliability and reduced life cycle costs. The joint Air Force/Navy development of a high accuracy ring laser-gyro (RLG) to increase cruise missile strike capabilities and provide motion compensation advanced sensors is a major navigation effort. The FY 1987 program continued development of a High Accuracy RLG Brassboard INS. The FY 1988 planned program completes High Accuracy RLG Brassboard INS flight test and evaluation; investigates the feasibility of a strapdown stellar-inertial system for application to strategic aircraft and as a guidance system update for future hypervelocity vehicles; and initiates development of an advance Global Positioning System (GPS) receiver architecture for enhanced jam resistant capability. The FY 1989 plan will complete feasibility analysis of a strapdown stellar-inertial system; continue development and design of an advanced development model enhanced GPS receiver for laboratory evaluation in FY 1990. Funding requirements are based upon the cost of contracts for similar technology efforts and are Category IV, Planning.

B. (U) Project: 2735, Advanced Systems Avionics Applications. This project provides the system technologies needed for the integration of offensive, defensive, communications, navigation, and identification avionics into a cohesive, fault tolerant weapon system. Due to funding limitations, current efforts concentrate on the in-house assessment of advanced integration technologies. The FY87 program continued the effort to develop and maintain the Avionics Systems Analysis and Integration Laboratory (AVSAIL) Integrated Test Bed (ITB) in preparation for the forthcoming integration of critical avionics technologies such as VHSIC MIL STD-1750 processors, fiberoptics high-speed data busses, communication protocols, Ada real-time reconfigurable software, and advanced displays and initiated the effort to develop an Ada Graphics Software Support System (AGSSS). The FY88 and FY89 programs include the integration of key critical technologies, the integration of the Integrated Terrain Access and Retrieval System (ITARS), which could form the basis of a Survivable Penetration and Attack system, and the completion of the AGSSS effort. In FY 1990 and beyond this project will design, develop, and perform in-house assessment of the PAVE PACE program which will provide the next generation architectures and technologies necessary to incorporate machine intelligence into upgraded versions of the F-15, F-16, B-1B, and Advanced Tactical Bomber, as well as the Advanced Tactical Fighter and National Aerospace Plane. Capitalizing on revolutionary electronic packaging and cooling concepts and fail-safe, fault tolerant electronics, the PAVE PACE program will also provide airframe quality reliability to avionics.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

Program Element: 0603253F Title: Advanced Avionics Integration
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) Project: 2733, Advanced Reconnaissance/Strike Radars

A. (U) PROJECT DESCRIPTION: This project develops and demonstrates advanced airborne radar system techniques addressing the Air Force's requirement for improved in-weather target acquisition for reconnaissance and strike applications. Technology efforts emphasize achieving improved detection, acquisition, and location of fixed, relocatable and moving strategic or tactical targets while considering operational, availability, affordability, and survivability requirements. The Ultra Reliable Radar (URR) effort is developing next generation radar technology, capitalizing on the solid state phased (or active) array (SSPA) and very high speed integrated circuit (VHSIC) technologies to demonstrate: 1) a radar technology with a new level of radar system availability; 2) the application of a new VHSIC data/signal processing technology to real-time, multimode radars; and 3) the application of SSPA technology to airborne, multimode radars. The Radar Air-to-Ground Target Acquisition System will demonstrate the technology required for automatically detecting, classifying, and locating fixed, moving or relocatable targets in real-time within the operational and physical constraints of fighter or bomber aircraft. The Concealed Relocatable Target Detection Radar System effort will demonstrate a high performance, foliage penetration radar imaging system.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Initiated Ultra Reliable Radar (URR) hardware fabrication phase. Initiated receiver, stalo, power supply subassembly testing phase. Initiated URR software implementation phase. Initiated software debugging with software development tools.

(2) (U) FY 1988: Congressional budget cuts to the FY 1988 Program Element (PE) have eliminated all efforts planned for the year. Attempts are being made to find other sources of funding to carry on some level of effort which will be dependent on the amount of funds, if any, found. If no funds are found in FY 1988 the URR Program will be phased out.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Initiate efforts for development and demonstration of advanced high performance, jam resistant Air-to-Air (A/A) radar techniques. Initiate detailed design phase for Radar Air-to-Ground Target Acquisition System (A/G Target Acquisition System). Initiate development of concealment relocatable Target Detection Radar System.

(4) (U) Program to Completion: Continue development of advanced A/A radar through rooftop and flight testing. Continue support of Air/Ground Automatic Target Acquisition development. Initiate development of a Concealed Relocatable Target Detection system. Initiate development of an Advanced Counter Low Observable System. This is a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Initiate Adv A/A Techniques Dev | Jul 1989 |
| (2) (U) Initiate Radar A/G Tgt Acq Sys Dev | Aug 1989 |
| (3) (U) Initiate Conc Rel Tgt Det Radar Dev | Sep 1989 |
| (4) (U) Initiate Adv A/A Rooftop Tests | Oct 1989 |
| (5) (U) Complete Conc Rel Tgt Acq Radar Sys Analysis | Jun 1990 |
| (6) (U) Initiate Advanced Raid Assessment Dev | Jul 1991 |
| (7) (U) Complete Radar A/G Tgt Acq Sys Detailed Design | Aug 1991 |
| (8) (U) Complete Conc Rel Tgt Acq Radar Sys Design | Sep 1991 |

(U) Explanation of Milestone Changes: All the milestones have been slipped to the right because of the Congressional budget reductions to the FY 88 budget.

9. (U) COOPERATIVE AGREEMENTS: N/A

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603269F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: National Aerospace Plane (NASP) Technology Program
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | (110,000)[1] | 183,000 | 244,767 | 2,251,733 | 2,679,500 |
| 3384 | NASP Technology Program | (110,000)[1] | 183,000 | 244,767 | 2,251,733 | 2,679,500 |

Note 1: In FY 1987 the NASP program was funded in Defense Advanced Research Projects Agency (DARPA) and the Strategic Defense Initiative Organization (SDIO) by Congressional direction ($100 million in DARPA and $10 million in the SDIO).

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a Science and Technology effort. This program element funds the Department of Defense (DoD) portion of the joint DoD/National Aeronautics and Space Administration (NASA) technology development and demonstration program known as National Aerospace Plane. The NASP program will develop the technological basis for aircraft capable of long range hypersonic cruise in the atmosphere and for space launch vehicles capable of single-stage-to-orbit performance with take-off and landing from a conventional runway. These technologies will then be demonstrated in a manned flight research vehicle, the X-30. These demonstrated technologies would then provide the basis for military (and civil) vehicles capable of: global unrefueled operation, reaching any point on the earth in two hours or less; providing routine, "on demand" access to near space; reducing payload to orbit cost by an order of magnitude; and flexibly based, rapid response space launch. Such NASP-derived systems would provide a revolutionary increase in military capability. The NASP is envisioned to be an airbreathing, hydrogen fueled, single-stage-to-orbit vehicle, capable of operating (horizontal takeoff and landing) from conventional runways. This effort continues work done under the DARPA Copper Canyon program which is now referred to as Phase I of the NASP program. The program is currently in Phase II, technology development. If the technological assessment continues to be positive, the program will proceed to Phase III, where an experimental vehicle will be designed, fabricated, and flight tested. The NASP program combines funding commitments by the Air Force, DARPA, Navy, SDIO, and NASA. It is a jointly managed program with all DOD funds consolidated in the Air Force for FY 1988 and beyond. The Air Force has overall DOD management responsibility with DARPA leading technology efforts for the current phase. In addition to technology investigation, initial efforts will include definition of military missions and design specifications such as survivability, payload requirements, and study of advanced technology applied to logistics areas such as reliability, maintenance, fuel processing and payload integration processing.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | (110,000) | 236,039 | 306,288 | 1,939,666 | 2,481,993 |

EXPLANATION: (U) The FY 1988 decrease reflects a Congressional funding reduction. The FY 1989 decrease reflects the program stretchout caused by the FY 1987/1988 congressional reductions. Increases in the to completion and total cost reflect the program stretchout necessitated by the FY 1987 and FY 1988 Congressional reductions.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This is a joint Department of Defense (DoD)/National Aeronautics and Space Administration (NASA) program. DOD program participants are the Air Force, Navy, Defense Advanced Research Projects Agency (DARPA), and Strategic Defense Initiative Organization (SDIO). The participation of the DoD organizations is governed by a Memorandum of Agreement (MOA), dated 25 April 1986, signed by all parties and by the Under Secretary of Defense for Research and Engineering. In FY 1987, NASP efforts were conducted by express congressional direction under PE 0603269F, National Aerospace Plane Technology; and PE 0603224C, SDI - Survivability, Lethality and Key Technologies. In FY 1988 and beyond, all DoD funding is in PE 0603269F. NASA participation with DoD is governed by a Memorandum of Understanding (MOU) dated 31 March 1987 between the Secretary of Defense and the NASA Administrator.

6. (U) WORK PERFORMED BY: The Air Force is assigned overall DoD responsibility. DARPA, with the Air Force acting as executive agent, is managing the Phase II technology development effort with participation by the Navy, SDIO and NASA. The Air Force will manage the Phase III vehicle fabrication and flight demonstration phase. A Joint Program Office has been established at Wright-Patterson AFB, OH. Actual technology development is being conducted by contractors, universities, and in-house government laboratories. The SDIO will maintain high level review of the program. Contractors for engine module development are Pratt and Whitney, West Palm Beach, FL; and Rocketdyne, Canoga Park, CA. Contractors for airframe component development are General Dynamics, Fort Worth, TX; Rockwell, Los Angeles, CA; and McDonnell-Douglas, St Louis, MO. There are 37 additional contractors with contracts totalling $321 million.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project 3384, NASP Technology Program

A. (U) Project Description: The project will develop the technologies to enable an assessment of the feasibility of constructing and flying a hypersonic research aircraft capable of horizontal takeoff and landing, sustained hypersonic cruise in the atmosphere, and direct insertion (single stage) into orbit. This project contains technology development efforts in advanced propulsion concepts; advanced airframe design; high temperature, high strength, lightweight materials; computational fluid dynamics; and advanced thermal control technology. The project is creating a broad technology base, generic in nature, which will support advanced engine and airframe development and result in significant program risk reduction. Engine modules embodying advanced concepts such as ramjet with supersonic combustion (scramjet) will be built and tested. Airframe components will be designed, built, integrated, and tested with the engine modules. If the assessment is favorable, two X-30 experimental flight research test-bed vehicles will be designed, built, and tested through an experimental flight research program.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Based on detailed reviews of contractor preliminary designs, there was a down selection to three airframe contractors (McDonnell-Douglas, General Dynamics, and Rockwell) and two propulsion contractors (Rocketdyne and Pratt & Whitney). All selected contractors produced conceptual designs that met the long range hypersonic cruise requirement and also met the single-stage-to-orbit requirement, which remains the prime goal of the program. The remaining efforts in the Phase II program will be aimed at increasing the confidence (reducing the risk) in the assumptions used to achieve these designs. Computational fluid dynamics calculations were expanded to include more detailed designs modeled over a broader range of simulated flight conditions. Specimens of new, advanced materials, including metal-matrix composites, ceramic composites and advanced titanium alloys, were fabricated and tested at representative temperatures and loading conditions. Research was conducted and designs developed for advanced cooling concepts, integral reaction control systems, advanced electrical energy generation, and advanced avionics systems. Design efforts leading to the fabrication of critical engine components and selected sub-scale airframe components were conducted. Mission application studies were continued and expanded. Preliminary vehicle fabrication studies and flight test planning were initiated. Contracts to upgrade engine test facilities were let.

(2) (U) FY 1988 Program: Work will continue on complex computational fluid dynamics calculations, with the refinement of computer models based on initial airframe and engine component test data. Modeling, utilizing supercomputer capabilities will include external and internal aerodynamics, aerothermodynamics, kinetics, and thermo-structural loading. Work will continue in the characterization and development of advanced materials and manufacturing technologies will be investigated. Construction of some selected engine and airframe ground demonstration components will begin. Components of tank structure for cryogenic fuels will be designed. Engine test facilities will begin initial checkout runs. Design of propulsion vehicle control systems, including sensors and actuators, will begin. Vehicle fabrication planning and flight test planning will continue. Mission application studies and survivability analyses will continue. The engine and airframe contracts are firm fixed price with not-to-exceed options through FY 1989. Cost estimates based on firm designs with contractor backup (Cost Category II, Mature).

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Materials, computational fluid dynamics, control systems and other key technology work begun in FY 1988 will continue while initial engine/vehicle control airframe design integration is refined. Each airframe contractor will continue and further refine preliminary designs for the X-30 flight research vehicle. Major program reviews will be conducted of the propulsion contractor designs. A major materials development program will come to fruition as scale-up of advanced technology durable high temperature resistant materials to sizes suitable for fabrication of major X-30 structural components will begin. Fabrication of major structural demonstration components for design technology validation testing will be initiated at each of the three airframe contractors. These components will include such critical vehicle structures as the wing fuselage attachment structure, crogenic tankage for liquid hydrogen and liquid oxygen, and a major fuselage section. Later testing of these components will prove the soundness of the various design approaches being taken by each contractor and will form a major input into the competitive down-selection process for the award of the final X-30 development contract. Engine component testing will be completed and fabrication of full scale hypersonic scramjet engines will begin in preparation for FY 1990 engine ground tests. Assessments will be made of the engine, airframe, and other key technologies as well

as readiness to enter into fabrication of an experimental flight vehicle. Cost estimates are based on firm design with contractor backup (Cost Category II, Mature).

(4) (U) Program to Completion: Technology development will continue to enable the viability of single-stage-to-orbit and sustained hypersonic cruise operation to be evaluated. Assessments will be made of engine, airframe and key technologies as well as readiness to enter into fabrication of experimental flight vehicles. Studies will be made as to the feasibility of a decision to design and build an experimental flight demonstration vehicle. If the decision is favorable, after an extended competitive demonstration program one engine and one airframe contractor will be selected to design and build the X-30 flight research vehicle. Two X-30 flight research vehicles will be designed and fabricated as well as a structural article for static and fatigue ground test. After extensive ground testing (including airframe static and fatigue strtuctural tests) an X-30 flight test program will be conducted followed by a carefully structured flight research program will be conducted to demonstrate the viability of single-stage-to-orbit and sustained hypersonic cruise operation. Assessments of operational utility and application will be completed to provide data for the potential use of these technologies in follow-on operational vehicles.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Engine/Airframe Design Reviews | | 4th Quarter FY 1987 |
| (2) (U) Engine Module Ground Test Complete (Phase II) | *(4th Quarter FY 1989) | 3rd Quarter FY 1990 |
| (3) (U) Technology/Survivability/Vulnerability Assessment | *(4th Quarter FY 1989 | 3rd Quarter FY 1990 |
| (4) (U) Research Vehicle Preliminary Design Review (Phase III) | *(3rd Quarter FY 1990) | 2nd Quarter FY 1991 |
| (5) (U) First Flight of the X-30 (Phase III) | *(2nd Quarter FY 1993) | 1st Quarter FY 1995 |

* Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Changes

(2) (U) Completion of Engine Module testing slipped nine months due to FY 1988 Congressional funding cut.
(3) (U) Assessment slipped nine months due to FY 1988 Congressional funding reduction.
(4) (U) Preliminary Design Review slipped nine months due to FY 1988 Congressional funding reduction.
(5) (U) First Flight of X-30 slipped twenty-one months due to FY 1987/1988 Congressional funding reductions and FY 1989 program budget reduction.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603270F 1 — Title: Electronic Combat Technology

DOD Mission Area: 551 - Electronic & Physical Sciences (ATD) — Budget Activity: 2 - Advanced Techology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 38,443 | 36,147** | 35,667 | Continuing | N/A |
| 691X | Electronic Warfare Technology | 14,398 | 11,542** | 10,120 | Continuing | N/A |
| 2432 | Warning and Power Management Systems Technology | 5,286 | 6,216** | 6,990 | Continuing | N/A |
| 2754 | $C^3$ Countermeasures Technology | 1,979 | 2,828** | 2,367 | Continuing | N/A |
| 2222 | Advanced Electro-Optical Countermeasures | 9,261 | 7,251** | 6,130 | Continuing | N/A |
| 431G | Electro-Optical Warfare | 7,519 | 8,310** | 10,060 | Continuing | N/A |

**Funds reflected in 0604241F - Consolidated EC PE established by the direction of Congress.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides advanced development in the area of electronic warfare where an expanded technology base is needed to solve critical penetration aid problems for all classes of infrared, electro-optical, and laser threats. The program includes , advanced Electronic Warfare (EW) transmitters, receivers, advanced power management, and command, control, and communication countermeasures. This program also provides for component, technique and subsystems development leading to the reduction of acquisition and life cycle cost of electronic warfare equipment and systems.

NOTE 1: This PE was included in the consolidated EW PE 0604241 in FY 1988 at the direction of Congress. Further, this PE was previously numbered PE 0603743F in FY 1987 and prior.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 37,653 | 41,288 | 47,600 | Continuing | N/A |

(U) EXPLANATION: Reduction in FY 1988 Congressional and the resulting cap which reduced the FY89 science and technology programs within Air Force TOA.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. RELATED ACTIVITIES: This program now incorporates, under one PE, the work covered in prior years by PE 63718F, Electronic Warfare Technology, and PE 63743F, Electro-Optical Warfare. The work is closely coordinated with related Army and Navy efforts through Joint Reviews conducted by the Joint Director of Laboratories/Technical Panel for Electronic Warfare and is coupled with the engineering development community of the three services through the Joint Technical Coordinating Group for Aircraft Survivability and Electronic Warfare. Exploratory development technology is phased into this program from PE 62204F, Aerospace Avionics and from related Army and Navy programs. Technology Transition Plans are prepared for major efforts undertaken within this PE addressing technology transfer to full-scale development programs within the Air Force. Completed electronic warfare (EW) efforts are transitioned into the engineering development programs: PE 64220F, EW Counter Response; PE 64710F, Reconnaissance Equipment; PE 64724F, Tactical Command and Control ($C^3$) and Communications Countermeasures; PE 64738F, Protective Systems; PE 64737F, Airborne Self-Protection Jammer; and PE 64739F, Tactical Protective Systems. Joint Air Force/Navy efforts include the Infrared Chaff, and the Advanced Infrared Countermeasures jammer programs.

6. (U) WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson AFB, OH, manages the program. Testing is performed primarily at the Air Force Armament Division, Eglin AFB, FL, and the Tonopah Test Range at Nellis AFB, NV, although other DOD test facilities are sometimes used. The major contractors are: Westinghouse, Baltimore, MD (2222, 2432 & 691X); General Electric Corp, Binghampton, NY (2222); TRW, San Diego, CA (2432); Raytheon, Goleta, CA (691X & 24320); and Northrop, Rolling Meadows, IL (691X & 2432). There are approximately twenty-four other contractors. Also, the Rome Air Development Center, Griffiss AFB, NY, manages two tasks in Project 2754, $C^3$ Countermeasures.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 2754, $C^3$ Countermeasures Technology: This project consolidates Command, Control and Communication Countermeasures ($C^3CM$) efforts designed to develop and demonstrate counters to enemy $C^3$ systems. Major thrusts include: airborne jamming and deception techniques; drone-borne

and expendable $C^3CM$; and analysis, simulator and evaluation support. In order to accomplish their assigned missions and improve aircraft survivability, the Tactical Air Force (TAF), Strategic Air Command (SAC) and Electroni Command (ESC) require a combined air and ground capability to degrade selected enemy communication links, integrate this information into the signals intelligence network, and display enemy ground controlled intercepts and prevent effective use of Surface-to-Air Missiles (SAM) and Anti-aircraft Artillery defenses. This is a technology base program which supports TAF General Operational Requirement 301-78, ESC SONs 1-80 and 3-80, and SAC Required Operational Capabilties 23-69. In FY 1987, the radar jammer module of the Mini-Drone Jammer was mounted on a helicopter and tested against an instrumented acquisition radar on the Eglin range as well as in Green Flag exercise at the Nellis ranges. The Mini-Drone Jammer is targeted against

Further, Development of a Command, Control and Communications Countermeasures ($C^3CM$) transmitter module was initiated that will markedly

The FY 1987 program continued a

The other major efforts were the initiation of the

jammer development and free flight of Mini-Drone Jammer, Wideband

$C^3CM$, spectrally pure (power sharing) transmitter

The planned FY 1988 program continues the Strategic Link Jammer, low band HF $C^3CM$, Wideband

spectrally pure transmitter, and risk reduction development of

The only new start will be development of a $C^3$ Sensor Signal Fusion Project to supplement the Strategic Link Jammer. In FY 1989, the program continues $C^3CM$ Advanced Mini-Drone Payloads development , completes Wideband $C^3CM$ design and laboratory demonstation, completes Low Band $C^3CM$ development and test efforts, completes the Matchwell Sensor Data Fusion effort, and initiates brassboard development and field test of a Wideband $C^3CM$ system. Cost estimates are Category III, Budgetary.

B. Project 2222, Advanced Electro-Optical Countermeasures: The primary purpose of this project is to develop technology for detecting and countering

directed threats to aircraft. Virtually all tactical Soviet surface-to-air weapons employ

either as their primary modes of

In addition to such threats, the

is also addressed from a countermeasures standpoint. Under this project the overall systems technology is developed, as well as the necessary supporting component technology. The approaches considered under this project address

of threats of concern, as well as threat detection and countermeasures approaches. Continued development of the CORONET PRINCE prototype will occur in FY 1988 intending to design, develop, fabricate, assemble, and flight test an

The HAVE LAW program will be initiated in FY89 to develop a concept for an

To facilitate this, studies were continued to define the effects of

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8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 691X, Electronic Warfare Technology

A. (U) Project Description: This project provides advanced development of new countermeasures techniques and hardware for both existing and new radio frequency electronic warfare systems. The project includes the following areas: (1) a supporting simulation effort that guides the allocation of funding through the evaluation of new concepts and techniques; (2) systems components and techniques needed to jam enemy radar; (3) on-board jamming systems, component and techniques needed to jam enemy radar; (4) off-board or expendable systems to confuse enemy radars and dilute enemy defenses; (5) electronic collection systems to inform the field commander of changes in the electronic environment; (6) the development of standardization and low cost reliable and maintainable components and systems to enable the Department of Defense to better afford the increasing amount and sophistication of electronic countermeasures equipment required on modern aircraft; and (7) development of advanced stand-off jammer technology that will lead to greatly reduced on-board countermeasures requirements. The enemy air defense network is characterized by both airborne and land based radar and communication systems that locate, monitor, guide and control offensive and defensive elements. The enemy continues to improve these elements against our forces and our operational countermeasures. This requires a strong technology base to provide demonstrated counters to these improvements and avoid technological surprises by new enemy threat systems. This project is a technology base effort which supports Tactical Air Command Statement of Operational Needs (SONs) 315-73, 301-78, and 304-80; Strategic Air Command SONs 23-69, 13-73, 6-81; and Military Airlift Command SONs 7-81, 8-81, and 9-81.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: Completed tri-service , jamming and chaff efforts, AF/Navy hi power transmitter, advanced radar signal high speed recognizer effort, Electronic Countermeasures (ECM) simulation and evaluation. Continued solid state jammers for stand-off and selfprotection, development of a lower cost, high reliability, Continued EW hardware developments, development, update New starts include terrain reflectivity measurements, reliability and maintainability EW study, sidelobe suppression countermeasures, Traveling Wave Tube improvement efforts, brassboard, and Military Airlift Command (MAC) EW suite development, targeted

(2) FY 1988 Program: Continue efforts including Electronic Countermeasures simulation and modeling, of antennas and EW subsystems, technology, improved chaff/expendables, EW, active Radio Frequency (RF) expandable, improved capability for stand-off aircraft (EF-111A), development of a lower cost, highly reliable countermeasure risk reduction,

high effective radiated power jammers, MAC EW, and development. Cost estimates are Category III, Budgetary.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continue R&M efforts to include standard EW architectures to be included within/parallel airframe design programs specifically focusing on modular, VHSIC based design criteria. Continue EW Techniques Analysis and Penetration Aids Evaluation to analyze and evaluate promising EW technologies prior to development. Continue New Chaff Technology, Multi-Spectral and Dilution Drone developments to augment off-board countrmeasures solutions for strategic and tactical penetration. Continue development of ALQ-99 Band 7/8 solid state transmitters and ECM subsystems. Continue fabrication, flight test and evaluation of an EW Suite for MAC aircraft Cost estimates are Category III.

(4) (U) Program to Completion: This a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Advanced System Eval Flight Test | August 1987 |
| (2) (U) Solid State Amplifier Ground Test | April 1988 |
| (3) (U) High Power Technology Flight Test | Aug 1988 |

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 431G, Electro-Optical Warfare

A. Project Description: This project demonstrates advanced development countermeasures against enemy air defense guidance systems which operate in the infrared (IR) spectrum. Examples of such systems are IR heat seeking missiles which home in on aircraft jet engines and aircraft. Improvements in these systems and development of new weapons using of the infrared spectrum require continuing development to gain and maintain an advantage over the threat. In the past, air defense systems operated only in the communications and radar frequencies However, Efforts in this project include a supporting simulation and analysis effort that guides the allocation of funding through the evaluation of new concepts and techniques to prevent or delay detection of U.S. Air Force aircraft, receiver systems for aircraft to warn crewmembers and activate countermeasures and decoys, and jammers to counter enemy air defense weapons. This project is a science and technology effort which supports Tactical Air Forces Statements of Operational Need (SONs) 20-68, 312-75, 304-80, 312-80, Strategic Air Command Required Operational Capability 4-76, and Military Airlift Command SONs 7-81, 8-81, and 9-81.

Program Element: 0603270F Title: Electronic Combat Technology
DOD Mission Area: 551-Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: The program for FY 1987 completed analysis and effectiveness of counter measures techniques, simulations using the Dynamic Infrared Missiles Evaluator facility, development of sources, and countermeasures against The Silent Attack Warning System (SAWS) was initiated to develop and demonstrate a capability for Completed development and testing of the Aerodynamic Flare, investigation of for warning receivers, and the direction finding technology effort. New starts for FY 1987 were an advanced on-board jammer using sources in a closed loop system to counter advanced warning receiver, and demonstration of a system that provides missile warning for attack from the Finally, the High Performance IR Decoy program will begin to develop technology to

(2) FY 1988 Program: The efforts in expendables, specifically the Advanced Aerodynamic Flare, will address the increasing flare rejection capability of IR seeker threats. The following programs will address improvement in detecting and locating missile and aircraft threats. The Silent Attack Warning System addresses

Future warning systems are supported by a current program to develop monolithic detector arrays to replace scanning infrared technology. Also applicable to threat warning is continued effort to demonstrate an IR window having optimum transmission properties with a minimal drag penalty. Development of modulated laser sources for use with a future laser jammer will also be pursued.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The will be reviewed for possible transition out of the laboratory into an aircraft Program Office targeted to the manned bomber fleet. A SAWS demonstration and ground test program will begin as well as a field test of the Warning System. Cost estimates are Category III, Budgetary.

(4) (U) Program to Completion: This is a continuing program.

C. (U) MAJOR MILESTONES:

| Milestones | Dates |
|---|---|
| (1) (U) Silent Attack Warning System Design Review | July 1987 |
| (2) (U) Miniaturized Laser Warning Critical Design Review | December 1987 |
| (3) (U) High Performance (IR) Decoy | August 1988 |
| (4) (U) Advanced IR Countermeasures Design Review | September 1989 |
| (5) (U) Silent Attack Warning System Field Test | November 1989 |
| (6) Warning Field Test | November 1989 |

11. (U) COOPERATIVE AGREEMENTS: Not Applicable

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## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603302F  Title: Space and Missile Rocket Propulsion
DOD Mission Area: 553 - Engineering Technology (ATD)  Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 5,604 | 6,259 | 8,995 | Continuing | N/A |
| 6339 | Air-Launched Missile Propulsion Technology | 1,800 | 700 | 2,100 | Continuing | N/A |
| 6340 | Space Systems Propulsion Technology | 3,504 | 3,359 | 4,495 | Continuing | N/A |
| 6341 | Ballistic Missile Propulsion Technology | 300 | 2,200 | 2,400 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program provides advanced rocket propulsion technology for tactical and strategic weapons and space systems to increase mission capabilities and improve reliability and maintainability. It demonstrates the technology to reduce cost and risk for future weapon systems development. This is the only Air Force program that integrates and demonstrates rocket propulsion technology for space systems, ballistic missiles, and air-launched missiles. The efforts in this program do not duplicate tasks conducted under the Strategic Defense Initiative.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 5,706 | 8,973 | 12,208 | Continuing | N/A |

EXPLANATION: FY 87 and FY 88 differences were due to Congressional reductions. The result of the FY 88 reduction was to delete one effort (in Project 6340), delay completion of two efforts (one each in Project 6339 and 6340), and delay the start of one effort (in Project 6341). The FY 89 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: This program demonstrates technology developed initially in the exploratory development program 0602302F, Rocket Propulsion. These two programs are the total Air Force investment in rocket propulsion science and technology. Coordination with other Department of Defense organizations is accomplished through the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee. The subcommittees have working-level members from all agencies to coordinate all technology and system development to preclude duplication of efforts.

6. (U) WORK PERFORMED BY: This program is managed by the Air Force Astronautics Laboratory, Edwards AFB, CA. All work is done under contract. The current contractors are Hercules Inc, Rocket Center, WV (6339); Rockwell

International, Rocketdyne Division, Canoga Park, CA (6340); Aerojet Tech Systems Co., Sacramento, CA (6340); Ball Aerospace Systems Division, Boulder, CO (6340); and Aerojet Strategic Propulsion Co, Sacramento, CA (6341).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 6339, Air-Launched Missile Propulsion Technology. The objective of this project is to demonstrate advanced rocket propulsion technology for a variety of air-launched missile concepts. The demonstrations are performed in a representative size to be applicable to several systems. Demonstrations are necessary to reduce technical risk to acceptable levels leading to full-scale development of missile propulsion systems. The current contract will demonstrate a high performance/low observables motor, a unique pulse-motor concept, that allows the rocket propellant to be burned in three discrete pulses with a coasting, or delay, period between each pulse. This segmented motor concept will reduce motor production costs and increase missile range or provide mission flexibility not possible with a one-piece rocket motor. This program will also reduce the rocket-motor plume by using a low-observables propellant, to the point that detection is extremely difficult. Timing of the motor pulses would allow a missile to turn sharply after launch or engage distant targets without compromising performance against closer-range targets. Increased range is possible because the missile can coast to conserve energy. Rocket motors using the new low observable/high energy propellant are difficult to detect because of the short burning times of each pulse and lower visable- and radar-signatures from the plume. The decrease in detection of the rocket motor protects the launch aircraft and denies the target a warning of the attack. A new thrust-vector control system will provide increased maneuvering during terminal engagements to increase the probability of kill. This program will demonstrate motors in full-scale ground tests and will provide flight-qualified motors for the Advanced Missile Technology Integration (0603363F) flight tests in 1992. Two contractors prepared motor designs in the initial phase of this effort. We selected one contractor on the merit of his design. We also finished design and analysis in FY 1987. Due to the Congressional reduction, the completion of component development for the high performance/low observable motor program will be delayed from FY 1988 to FY 1989. We will fabricate motors using the preliminary design and verify the component performance in ground-test firings of the motors in FY 1989.

B. (U) Project: 6340, Space Systems Propulsion Technology. Our objective is to demonstrate advanced propulsion technology for satellites and other space systems--principally for orbit maintenance, evasive maneuvering, and propulsion from low-earth orbit to higher orbits (e.g., geosynchronous). The Air Force's growing use of space requires low-cost, reliable propulsion systems. These demonstrations provide propulsion systems that will satisfy these requirements and fill a critical gap in satellite orbit transfer capability left by the cancellation of the Shuttle-launched Centaur program. Current systems have limited payload capability and lack flexibility. Two ongoing developments can provide high-performance satellite propulsion. First, the Flightweight XLR-132 engine is a modular, storable propellant, space-propulsion system that can be used in a single engine configuration for evasive maneuvering for survivability against the anti-satellite threat; we could also package several XLR-132s to provide a 140 percent increase in payload capability over that provided by the Inertial Upper Stage. The modular design allows the ability to cluster any number of engines in a separate stage or to integrate an engine with a satellite design. Use of storable propellants provides a capability for long-term operation in orbit. Use of the modular concept avoids large development cost of a propulsion system peculiar to a given satellite by using a proven, available engine to meet propulsion

requirements. The potential application of the modular, storable, space propulsion work was cited in technology transition plans for the Global Positioning System Block IIR changes (desired in FY 1988 to 1989), Defense Satellite Communication System III follow-on (desired between FY 1990 and 1992), Defense Support Program follow-on (desired from FY 1988 to 1990), and Upper Stage Propulsion Systems (desired in FY 1992). The second demonstration is a compact, cryogenic-propellant feed system, a liquid-oxygen tank that surrounds the engine in a doughnut shape. Using this tank on an upper stage operating out of a fixed volume cargo bay on the Shuttle or Titan launch vehicles would provide a one-third increase in the volume available for the payload over conventional spherical tanks. We directed a low expenditure rate, during FY 1987, for the Compact Cryogenic-Propellent Feed System program due to limited funds but were able to complete a substantial amount of design and analysis activities. We should be able to complete the design of the flightweight tank and oxidizer feed system in FY 1988 but will not be able to fabricate any of the full-scale components or a tank until FY 1989 because of limited funds. In FY 1987, the Flightweight XLR-132 (modular, storable, space propulsion) effort continued with completion of the engine design. We will complete component evaluation for the Flightweight XLR-132 engine and then proceed to the final design in FY 1988. Then, in FY 1989, the engine components will be assembled for ground-test firings of the complete flightweight engine to verify design performance. We responded to FY 1988 Congressional reductions by deleting work on the low-thrust, cryogenic-propellant engine (XLR-134) intended to transition from PE 0602302F. We will begin one new effort in late FY 1989. The new effort is an advanced space propulsion demonstration of an electric propulsion thruster. This arcjet thruster can provide performance increases of 65 to 120 percent over chemical propulsion.

C. (U) Project: 6341, Ballistic Missile Propulsion Technology. The objective of this project is to demonstrate advanced technology concepts for ballistic missile systems. It provides propulsion advances for increases in strategic force capability. The ongoing program, Advanced Integrated Stage Concept, is a revolutionary motor configuration nesting the forward dome of the first stage motor case into the nozzle of the second stage motor to increase the volume available for propellant or decrease the inert weight. The integrated stage configuration replaces the weight and volume-inefficient length of the interstage dedicated to packaging a conventional motor's exit cone. This concept could increase missile range from 10 to 27 percent or provide a smaller, lighter missile with the same range. In FY 1987, we slowed the pace of this program to match the available funds and were able to complete characterization of the boron propellant. We received Congressional direction for FY 1988, reserving $3.3 Million for the Integrated Stage Concept. However, the maximum expenditure we can achieve in FY 1988 is $2.2 Million, due to late release of funds and a low previous rate of expenditure. We will continue the work in FY 1988 by accomplishing the design of intermediate size motors to test components and the full size motor for final verification tests. In addition, we will begin designing and fabricating components. In FY 1989, we will begin the component development tests of the unique nozzle and aft motor section in preparation for the final design.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603363F
DOD Mission Area: 553 - Engineering Technology
Title: Hypervelocity Missile (HVM)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 9,273 | 10,626 | 6,577 | Continuing | N/A |
| 2718 | Hypervelocity Missile Technology Demonstration | 9,273 | 10,626 | 5,577 | 0 | 49,235 |
| 3254 | Advanced Missile Technology Integration | 0 | 0 | 1,000 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Hypervelocity Missile (HVM) system concept incorporates a small, fast, low-cost, command-guided missile to achieve multiple vehicle kills on a single pass. The high aircraft loadout, resulting from the small missile size and low cost, affords a significant increase in kills per sortie. The Air Force Armament Division has devised a technology demonstration program that will culminate with the air-launched flight test of multiple missiles being fired and simultaneously guided to two different targets. Targeting and missile tracking information will be provided by a forward-looking infrared tracking system. This program will demonstrate the feasibility of the HVM concept, and will provide a basis for the decision to proceed with full-scale development. The HVM system concept promises to give the United States an impressive increase in firepower for the anti-vehicular mission, at an equally impressive decrease in cost per target destroyed. The Army and Marine Corps also strongly support the system for use on both light assault vehicles and possibly on helicopters. A Memorandum of Agreement among the three Services' Assistant Secretaries was signed on 10 October 1984 establishing a joint effort to share the costs of developing common components and to conduct a joint ground-launched demonstration to validate the system concept. The Air Force is the lead Service in this effort, the first tri-Service antiarmor weapon development program. The Advanced Missile Technology Integration project (3254) for demonstrating technologies applicable to air-to-surface and air-to-air missiles will begin in FY 1989. The objective of this effort will be to integrate emerging air delivered missile component and subsystem technologies and demonstrate their performance and payoff potential through hardware-in-the-loop simulation and limited flight test. Air Force Systems Command's Air Force Armament Laboratory has lead responsibility for interfacing with the other Services as well as vehicle development, subsystem integration, and test. This project will serve as the basis for reducing risk and transitioning high payoff technologies from laboratory development to full scale development.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 9,382 | 11,626 | 7,783 | Continuing | N/A |

EXPLANATION: (U) FY88 Congressional action deferred AMTI funding until FY 89.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not applicable.

5. (U) RELATED ACTIVITIES: The US Army and US Marine Corps are working closely with the Air Force Armament Division (AD) on the Hypervelocity Missile (HVM) program, determining its potential for use on their light assault vehicles. The US Army and Marine Corps are also considering HVM for airborne applications. A Memorandum of Agreement (MOA) among the Air Force (AF), Army (USA) and Marine Corps (USMC) specifying that the three Services will share the costs of developing common components for their respective hypervelocity missile systems, was signed by the three Services' Assistant Secretaries on 10 October 1984. This MOA pertains to FYs 1984 through 1987, and will culminate in the successful ground launch and guidance of both the AF and USA/USMC missiles. The MOA also designates the Air Force as the lead Service. The USMC share of this program is ($10.0 million) being funded by PE 0603611M, Mobile Protected Gun System, and the USA share ($11.7 million) is funded by PE 0603313A, Missile/Rocket Components. The following AF programs will provide inputs to Advanced Missile Technology Integration (AMTI): Conventional Munitions (PE 0602602F); Conventional Weapons(PE 0603601F), Space and Missile Rocket Propulsion (PE 0603302F), and Advanced Turbine Fuel Technology (PE 0603215F)., Interrelationships between the technology integration project and other AF efforts are governed by the Memorandum of Understanding (MOU) signed by the Air Force Aero Propulsion Laboratory, Air Force Rocket Propulsion Laboratory, and the Air Force Armament Laboratory. An MOU has been signed by the AF Armament Laboratory, Naval Air Systems Command, and Army Missile Command's Research, Development and Engineering Center. This MOU will ensure proper coordination and interrelationship with the following related programs: Missile Technology (PE 0602303A), Surface/Aerospace Weapons Technology (PE 0602332N) and Flight Vehicle Technology (PE 0603205F).

6. (U) WORK PERFORMED BY: The Air Force Armament Division, Eglin AFB FL, is the responsible technical organization for this program. The US Army Missile Command, Huntsville AL, will provide support for US Army requirements; the USMC Development and Education Center, Quantico MCAS VA, for the Marine Corps requirements. Test facilities at the Armament Division, Eglin AFB FL, and the White Sands Missile Range NM, will be used to support the program. The primary contractor on this program is LTV, Vought Corporation, Dallas TX. AMTI, Project 3254, when initiated in FY 1988,

will be managed by the Air Force Armament Laboratory, Eglin AFB, FL, and contractors will be selected by competitive bid.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3254, Advanced Missile Technology Integration (AMTI). The purpose of this FY89 new start is to integrate and evaluate emerging air-to-surface and air-to-air missile component and subsystem technologies (guidance, control, fuze, warhead, propulsion, power). It will demonstrate the performance and payoff potential of guidance/control, fuze/warhead and propulsion/power subsystems through extensive hardware-in-the-loop simulation and limited flight test. This project will provide the mechanism for reducing risk, controlling costs and transitioning high payoff technologies from laboratory development to full scale development. In FY89 begin design and fabrication of a missile test bed using a test bed airframe, autopilot, and motor with a soft recovery mechanism. This project will initiate integration of advanced guidance laws developed under PE 0602602F, Conventional Munitions, into the test bed. The Air Force will initiate development of the digital and hardware-in-the-loop simulations needed to support the first series of flight tests which will begin in FY92. These initial tests will verify the flightworthiness and recoverability of the test bed, demonstrate the advanced guidance laws, and validate the simulation models. In FY91 complete integration of improved guidance laws and a Very High Speed Integrated Circuit (VHSIC) technology processor into the missile test bed fabricated during FY90, complete development and begin operation of the simulation capabilities required to support flight demonstrations of the processor and guidance laws and complete initial designs for integrating a pulse motor with the missile test bed. During future years, advanced guidance, warhead, fuze, autopilots, and propulsion subsystem technologies will be demonstrated and evaluated in both air-to-surface and air-to-air missile test beds.

B. (U) Project: 2718, Hypervelocity Missile Technology Demonstration. The HVM is a 5000 ft/sec, 66 lb., low cost (less than $8.5 thousand per missile in FY 85 dollars), multiple target engagement weapon system for use against all vehicles, including armor. The HVM system combines a lethal mechanism using a kinetic energy penetrator (rod or tube) with a command-guidance scheme to achieve a substantial reduction in missile size, weight and cost, while dramatically increasing the missile's flight velocity and the aircraft's combat loadout. These characteristics provide a marked increase in firepower-per-sortie, while simultaneously decreasing the aircraft's total exposure time. In FY 1987, missile fabrications and systems integration for the ground-launched tests were completed and packaging of the fire control system was initiated along with targeting system/missile/aircraft integration and qualification analyses. In FY 1988, firings of the twelve missiles for the ground-launched phase will begin. Single and multiple ground-launched flight tests will be completed. Concurrent studies will be initiated to address questions of full-scale development, production cost/schedule/risk, operational utility of the HVM weapon system concept for the Air Force's anti-vehicular mission, and weaponization concepts for tactical aircraft. Air-launched demonstration will begin in FY 1989 with missile/aircraft, targeting system/aircraft, and launch pod/aircraft integration and qualification. Successful completion of the air-launched tests in FY 1991 will conclude the HVM System Demonstration.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603401F — Title: Advanced Spacecraft Technology

DOD Mission Area: 410 - Space Launch and Orbital Support — Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 12,932 | 4,000 | 7,995 | Continuing | N/A |
| 2181 | Advanced Space Computer Technology | 9,674 | 2,200 | 5,100 | Continuing | N/A |
| 682J | Advanced Space Power Technology | 3,158 | 1,700 | 2,500 | Continuing | N/A |
| 2198 | Advanced Space Technology Assessments | 100 | 100 | 195 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This science and technology program defines, develops, and demonstrates improved spacecraft subsystem concepts/prototypes which support numerous DOD space programs. The developments are essential to assure DOD space mission needs are met in the early 1990s. The primary objective is to increase satellite performance, reliability and service life. A secondary objective is to improve the performance with lighter, less complex, and more survivable subsystems than currently exist. Efforts include: development of space computer subsystems, space power supplies, and space technology assessments.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 8,756 | 8,433 | 10,103 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 difference is due to Air Force reprogramming of related space technology efforts (LASERCOM and Dynamic Isotope Power Supply (DIPS)). The FY 1988 difference is congressionally mandated. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority. The impact of these major reductions will delay hardware delivery of hardened solar arrays and a space VHSIC breadboard computer by one year.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Project 682J receives power system technology inputs from PE 0602203F (Aerospace Propulsion). Project 2181 receives inputs from PE 0603452F (Very High Speed Integrated Circuits). The entire Advanced Spacecraft Technology program flight tests its payloads via PE 0603402F (Space Test Program).

6. (U) WORK PERFORMED BY: The Air Force Space Technology Center, Kirtland AFB, NM, manages the entire program and executes Projects 2181 and 2198. The Air Force Aeropropulsion Laboratory, Wright-Patterson AFB, OH, executes Project 682J. The primary contractors are TRW, El Segundo, CA and Boeing, Seattle, WA, (Project 628J). IBM, Manassas, VA and Honeywell Inc., Clearwater, FL have contracts in Project 2181.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2181, Advanced Space Computer Technology. This project funds space hardened microelectronics which increase the survivability and onboard data processing capability of military space systems. These satellites need advanced computer electronics, hardened to survive high levels of hazardous space radiation causing single event upsets and degradation of performance. Further, future missions will need up to 1000 percent improvement in onboard processing capability. Two contractors are developing chip sets of a space-qualified Generic Very High Speed Integrated Circuit Space Computer (GVSC) which began in FY 1987. The GVSC, by its generic nature, is designed to perform as a subsystem for rapid processing of data in a wide variety of special space-borne computers. We'll continue the GVSC development with test chips planned to be available in FY 1988. Delivery of a GVSC computer breadboard should be available for testing in FY 1989. We'll also begin developing a fast access memory in parallel with the GVSC program in FY 1989. In FY 1988 we will develop the 64K Random Access Memory (RAM) chip development (rad-hard). Currently, we only have 16K RAM chips hardened for space applications. The 64K RAM effort leverages work done at the Department of Energy and will produce a testable product by FY 1989.

B. (U) Project: 682J, Advanced Space Power Technology. This project develops and demonstrates power system technology for subsystems and components for spacecraft. These technologies provide increased power output, longer life and increased nuclear and laser hardness at substantially reduced volume, cost and weight. Development efforts include nickel-hydrogen batteries and survivable solar panels. A performance data base is being established by ground testing the batteries in simulated orbits. We began the life performance testing (lasting five years) of batteries in FY 1987 and will continue the test through FY 1992. The nickel-hydrogen battery is the next generation space battery and gives twice the performance of conventional nickel-cadmium ones. We began development of a Survivable Concentrating Photovoltaic solar Array (SCOPA) in FY 1987; SCOPA continues with two contractors in FY 1988. SCOPA guarantees increased performance and survivability against Soviet laser threats. SCOPA will finish Phase II development and provide a flight qualifiable solar panel in FY 1989.

C. (U) Project: 2198, Advanced Space Technology Assessments. This project evaluates the status of current space technology programs across DOD and focuses efforts into a single area to avoid duplication o. effort. In FY 1987, the space power and space communications assessments helped the Air Force decide on where to consolidate efforts. In FY 1988, we will use the space microelectronics study to judge the impact of over 12 separate programs on future satellite systems. Technology assessments to be delivered in FY 1988 and FY 1989 include radiation-hardened electronics, space sensors, and space environment.

Program Element: 0603401F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Advanced Spacecraft Technology
Budget Activity: 2 - Advanced Technology Development

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603410F    Title: Space Systems Environmental Interactions Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD)    Budget Activity: 2 - Advanced Technology Development

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

| Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 3,491 | 3,825 | 3,930 | Continuing | N/A |
| 2821 | Space Systems Design and Test Standards | 499 | 675 | 710 | Continuing | N/A |
| 2822 | Interactions Measurement Payload | 2,202 | 2,300 | 2,720 | Continuing | N/A |
| 2823 | Charge Control System | 790 | 850 | 500 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This science and technology program develops the scientific groundwork required for countering adverse effects of the space environment on Air Force space systems. New systems will not meet the most stringent requirements for survivability, reliability, autonomy and long-lived operation unless they are designed to mitigate these environmental effects. Environmentally induced problems identified by recent experiments from Shuttle and other satellites include: malfunctions of on-board micro-electronics; spacecraft charging/discharging during polar orbit; possible limits on manned operations due to charging/discharging of extra-vehicular activity equipment; decreased materials stability associated with increased contaminants; deformation of radar antenna or large-system optics; power loss and materials damage of large solar arrays caused by interaction with space plasma; and significant materials degradation. This program's goal is to quantify interaction effects and develop design guidelines, test standards, and computer-aided engineering tools for inclusion in military standards for advanced space systems. We'll deliver engineering design tools and a spaceflight-qualified charge control system to system developers. This program represents the Air Force advanced development portion of a National Aeronautics and Space Administration (NASA)/Air Force Systems Command (AFSC) Agreement for Space Interdependency on Spacecraft Environment Interactions.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 3,534 | 3,825 | 3,934 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 and 1988 reductions reflect adjustments in the Air Force Total Obligation Authority

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: NASA and the Air Force coordinate laboratory development in technology which this program transitions into solutions to specific space systems problems. Program Element 0602101F, Geophysics, at the Air Force Geophysics Laboratory, is a major contributor to advanced development in environmental interactions technology. The

Navy and the National Oceanic and Atmospheric Administration also conduct programs centering on the space environment. These efforts are reviewed and coordinated formally with PE 0603410F at the annual tri-service Science and Technology program review by the Office of the Under Secretary of Defense for Acquisition. The NASA/Air Force Space Technology Interdependency Working Group coordinates NASA/Air Force efforts continuously and reviews the programs at annual meetings.

6. (U) WORK PERFORMED BY: This combined in-house and contract program is being managed by the Air Force Geophysics Laboratory, Hanscom AFB, MA. The primary contractors are Jet Propulsion Laboratory, Pasadena, CA (2822); Hughes Research Laboratories, Malibu, CA (2823); S-Cubed Incorporated, La Jolla, CA (2821); Rockwell Space and Electronics Division, Seal Beach, CA (2821); and SRI International, Menlo Park, CA (2822). In addition to our top five contracts, we have one additional contract with a dollar value of $0.8 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2821, Space Systems Design and Test Standards. This project applies the results of NASA and Department of Defense space environment interaction research and technology development to produce design guidelines and test standards to alleviate environmental sensitivities in space system designs. In FY 1987, scientists finished work on computer-aided engineering (CAE) design tools--computer programs which adapt sophisticated computer models for charge buildup on spacecraft into easily accessible design tools for spacecraft developers. Charge build-up on spacecraft--one of the most serious space environment hazards--can degrade system operation, cause damage to the spacecraft, and reduce system performance. Preparation continued on the Spacecraft Environmental Anomalies Military Handbook for developers and operators to use as a guideline for reducing environmental sensitivities of spacecraft. Validation of the Polar Orbit Large Object Charging (POLAR) computer code for use by spacecraft designers continued. During FY 1988, the CAE tools will be transitioned to the Space Division acquisition and logistics office for general use by spacecraft designers. The Spacecraft Environmental Anomalies Military Handbook will be completed, reviewed and turned over to Space Division for publication. Work will begin to prepare military handbooks--design and test guidelines--covering spacecraft sensitivities to charging at geosynchronous altitude and in low-earth-orbits. Contract work will begin on a military standard with supporting military handbook to define the space environment. This standard will become a contractual document that all Department of Defense spacecraft developers can use as reference. We will contract work to specify/classify material interactions in space for several future specific space missions. POLAR computer code validation continues using recent spaceflights to corroborate the accuracy of this model. During FY 1989, work will be completed on the Space Environment Handbook/ Standard and the POLAR computer code validation. This work is for the SPO offices for specifying the design requirement to space program contractors to accommodate the space environment. Work will continue on the geosynchronous altitude spacecraft charging handbook. We'll also initiate a new effort to create a military handbook and standard on contamination of on-orbit space systems.

B. (U) Project: 2822, Interactions Measurement Payload (IMPS). This project designs, fabricates and flight tests comprehensive experimental packages to quantify environmental interactions known to affect planned operational systems. IMPS output will provide direct input and validation for Project 2821 efforts to develop guidelines and standards for planned military space systems. IMPS results will help avoid operational failures of future space systems due to

unanticipated adverse environmental effects. This project also includes efforts to investigate possible limits on manned or robotic operations due to electric charge buildup and discharge on extravehicular activity (EVA) and other electrically sensitive equipment. In FY 1987, we finished the design of the Photovoltaic Array Space Power (PASP) Plus Diagnostic (PASP Plus) equipment. This payload will collect engineering data on the voltage-current characteristic of several different solar array types, including the new concentrator array designs, while in the low altitude plasma. Instrumentation will also measure the electromagnetic interference and induced currents due to arc discharges. Planning for the astronaut extravehicular activity (EVA) ground and flight evaluation continued. Other small, simplified interactions payloads planning was begun to do Shuttle contamination photography and materials charging using the Surface Potential Monitor. In FY 1988, we will fully integrate the PASP Plus payload into one package consisting of the PASP experiment and equipment to measure arc discharge, plasma properties, and ambient neutral density. The measurements from this experiment will help us understand the cause/effect relationship between the natural space environment and arc discharge. We'll begin to define mission operations and data collection and analysis procedures, while continuing planning for the EVA equipment ground evaluation. Design and development of a compact, low-weight, low-power energetic anomalies sensor will begin. During FY 1989, fabrication of the PASP Plus payload will be completed and complete qualification testing will begin. This testing will be done prior to delivery to the Space Test Program for launch integration. Data evaluation techniques will be nearly complete. Mission planning for PASP Plus will continue for launch on either the Shuttle or an expendable launch vehicle. Planning for astronaut EVA and multibody plasma interactions studies will be completed. Development of the anomalies detector will continue.

C. (U) Project: 2823, Charge Control System (CCS). An automated CCS will be designed, developed, and flight tested to produce a spaceflight-qualified system to actively control electrical charge buildup on spacecraft. The buildup of large differential electrical charges on spacecraft and the subsequent catastrophic discharge (arcing) can degrade system operation, cause damage to the spacecraft and reduce system performance. In FY 1987, fabrication of the prototype CCS components began. During FY 1988, we'll complete flight prototype fabrication and begin qualification testing. Definition of spaceflight operational procedures, data collection, and data analyses methods will commence. In FY 1989 we'll finish flight prototype qualification testing. The CCS will be delivered to the Space Test Program Office for integration and testing on a suitable geosynchronous spacecraft, with launch anticipated in FY 1991. Spaceflight operational procedures and data evaluation plans will be largely completed. Support will be provided to start integration of the CCS on the host satellite.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603452F | Title: Very High Speed Integrated Circuits (VHSIC)
DOD Mission Area: 551-Electronic and Physical Sciences (ATD) | Budget Activity: 2-Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 126,426 | 100,000 | 44,086 | 0 | 927,260 |
| 2700 | VHSIC | 126,426 | 100,000 | 44,086 | 0 | 927,260 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: For many years the basic US defense strategy has rested on the premise that the numerical superiority of our adversaries could be offset by technologically superior weapons. Key to this strategy has been the incredibly rapid advances in integrated circuit technology which revolutionized weapon system design. The VHSIC program, a Tri-Service Science and Technology program, was initiated in order to accelerate the insertion of advanced integrated circuit technology into military sytems. The VHSIC plan is to develop two generations of very small size integrated circuits with very high information processing capacity for a wide range of military systems. Initial applications include digital signal processors for radar, antisubmarine warfare, communications, missile guidance, electronic warfare, and optical sensor systems. Payoffs include enhanced performance and reliability and reduced life-cycle cost. Many systems will not meet performance objectives or size, weight, and power limits without this component technology. The program structure stresses ready access to the technology by military system designers and rapid introduction of these components into the operational inventory. By Congressional direction, the program is centrally managed in the Office of the Under Secretary of Defense for Research and Advanced Technology, and the Air Force budgets for the total program funding for all the Services.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 123,868 | 101,413 | 58,127 | 0 | 940,730 |

EXPLANATION: (U) FY 1987 difference reflects restoration of funds to the program that were previously taken to accommodate undistributed cuts to the FY 1987 budget. FY 1988 difference is due to Congressional action. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This is a Tri-Service program with management and technical oversight executed by the Office of the Under Secretary of Defense for Research and Advanced Technology. The Director, Computer and Electronics Technology, in the Office of the Under Secretary of Defense for Research and Advanced Technology, coordinates the work within the program and work related to it. An Executive Committee, chaired by the Deputy Under Secretary of Defense

for Research and Advanced Technology, with participation by the Services and other concerned agencies, exercises oversight and sets program policy for the VHSIC program. Related activities include: Aircraft Avionics (PE 0602202A); Electronic and Electron Devices (PE 0602705A); Electron Device Technology (PE 0602762N); Aerospace Avionics (PE 0602204F); Aircraft Avionics Equipment (PE 0603207A); Avionics (PE 0603202N); Advanced Device Development (PE 0603742N); Advanced Avionics for Aerospace Vehicles (PE 0603203F); and Integrated Electronic Warfare System/Integrated Communications Navigation Identification Avionics Advanced Development (PE 0603109F). In addition, a major manufacturing program is in progress (PE 0708011F) to ensure VHSIC components are mature, available and affordable.

6. (U) WORK PERFORMED BY: The Office of the Under Secretary of Defense for Research and Advanced Technology executes program management of VHSIC. The work is monitored in the following organizations: Army Electronic Technology and Device Laboratories, Electronic Warfare Laboratory, and Communications Research and Development Command, all at Fort Monmouth, NJ; Army Missile Command, Huntsville, AL; Army Armament Research and Development Command, Dover, NJ; Army Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA; Army Research Office, Research Triangle Park, NC; Space and Naval Warfare Command, Naval Research Laboratories, both in Washington, DC; Office of Naval Research, Arlington, VA; Naval Air Development Center, Warminster, PA; Naval Surface Weapons Center, Dahlgren, VA and White Oak, MD; Naval Weapons Center, China Lake, CA; Naval Ocean Systems Center, San Diego, CA; Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, OH; and Rome Air Development Center, Griffiss Air Force Base, NY. The major VHSIC contractors are TRW, Redondo Beach, CA; Westinghouse, Baltimore, MD; Hughes Aircraft Corp., Carlsbad, CA; Texas Instruments, Dallas, TX; Honeywell Inc., Minneapolis, MN; IBM Corp, Manassas, VA; and Intermetrics, Baltimore, MD. There are 17 additional contractors holding contracts totalling $20 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2700, VHSIC

A. (U) Project Description: The VHSIC program objective is to deliver prototype integrated circuits and circuit chip sets, brassboard demonstration subsystems, pilot production lines, computer-aided design tools, and device technology. Numerous systems in the three Services have been identified as prime candidates for VHSIC chips. Projected system payoffs include 5- to 10-fold reductions in size, weight, and power consumption; 10- to 100-fold increases in reliability and processing throughput; and significantly reduced costs of maintenance, supply, and modification. The program is divided into two major phases providing integrated circuits. In Phase 1, first generation, militarized, very large-scale integrated circuits have been developed using 1.25 micrometer geometries--one-fortieth the size of a human hair--with an average of 20,000 logic gates per chip operating at 25 Megahertz. In Phase 2, second generation technology is being developed using submicrometer (0.5 micrometer) geometries--one hundredth the size of a human hair--with 75,000 to 5,000,000 gates per chip operating at 100 Megahertz. Additional efforts in the program include military qualification and manufacturing scrap rate reduction (yield) of Phase 1 chips, development of design automation tools to accelerate the design of advanced military systems using VHSIC technology and development of key lithographic tools for chip manufacture such as deep ultraviolet, electron beam, and x-ray techniques. The program also provides for rapid

and early demonstrations of the Phase 1 technology through the insertion program, in which VHSIC chips are engineered into hardware for test.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 program contained a balance of activities both to advance military very large-scale integration to the submicrometer regime needed for advanced high-throughput processors, and to support the use of VHSIC technology in military weapon systems. Phase 2 (submicron) contractors completed process development and initiated fabrication of a Bus Interface chip and/or a proof of concept demonstration. The completion of this chip fabrication will demonstrate that the contractors have established a process for fabricating a complex chip with 0.5 micron features. The qualification of VHSIC technology for insertion into military systems is a two-part effort. In part one, VHSIC manufacturers are qualifying at least one VHSIC device from the VHSIC Phase 1 family to current military standards to demonstrate that VHSIC is capable of meeting existing standards. Electrical specifications for five devices have been prepared with four being approved through the Defense Electronics Supply Center (DESC). Four manufacturers lines have been certified by DESC. The second effort is the development of a "generic qualification" procedure for a manufacturer's entire family of advanced devices, which will give system designers access to a wide range of fully qualified devices, even when very small quantities are required. These procedures are being reviewed as part of the process for developing a revision to existing military standards. The Tester Independent Support Software System (TISSS) software coding was completed and is in system integration and test stage of development. The object of TISSS is to automate the generation and maintenance of electrical test specification and test programs for VHSIC devices and to provide candidate standard interfaces to which test tools can be built. The VHSIC Hardware Description Language (VHDL) was accepted by the Institute for Electrical and Electronic Engineer (IEEE) Industry as standard IEEE-1076. VHDL is a comprehensive common design language which will allow for smooth transfer of VHSIC technology within the defense community. A pilot production line using the latest state-of-the-art X-ray lithography was initiated. This effort is needed to help establish manufacturing experience in using X-ray lithography to develop 0.5 micron circuits. Efforts on the VHSIC Engineering Information System (VEIS) were initiated. The VEIS is an object management system designed to manage engineering data.

(2) (U) FY 1988 Program: Submicron technology development will continue with Phase 2 contractors designing and developing VHSIC chips with 0.5 micron features. Phase 2 technology will offer a significant increase in system performance and reliability, and provide reductions in size, weight and power requirements needed by military system designers. Final demonstration and testing of the TISSS will be completed and will be made available for use by government and industry. TISSS will automate the generation and maintenance of electrical test specifications and test programs for VHSIC devices and provide a candidate standard interface to which test tools can be built. Approximately three VHSIC Phase 1 devices will be added to the military qualified parts list. Under generic qualification, initial verification of revised procedures for VHSIC chips will be completed. On completion of the demonstration, these procedures will be provided to government and industry organizations for final testing and verification. Efforts will be completed on the development of a pilot production line using X-ray lithography equipment. Current production optical lithography equipment is not capable of correct alignment for 0.5 micrometer feature size chips. Definition of the VHSIC Engineering Information System (VEIS) will be completed and implemented. Work on the development of system

level design automation tools will be completed. By using these tools designers can determine, through simulation early in development, if the projected architecture will perform the desired functions adequately. Simulation and synthesis software tools allow the system designer to rapidly assimilate new chip technology into weapon systems. Early demonstration programs emphasizing the rapid insertion of VHSIC technology will be completed. Examples include a programmable signal processor for the F-16 fire control radar, a speech processor for a Speech Enhancement Unit, and a signal processor for the E-3A surveillance radar. Funding estimates are based on detailed program planning and analysis performed by Service experts in such disciplines as design automation, manufacturing reliability and testing. The results from contract pricing, for efforts now in progress, also assist in developing funding esitmates.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of VHSIC submicrometer technology will be completed with delivery of chips for test and evaluation by the government. These chips include logic and memory chips. Some of these chips will be fabricated with as many as three million transistors with 0.5 micron dimensions on a single chip. These densities will be needed to meet the high throughput signal/data processing requirements of future systems. Work on developing and demonstration 0.5 micron pilot production lines will be completed. Successful production of 0.5 micron feature size chips will provide the system designers new integrated circuits for use in military weapon systems. The VHSIC Engineering Information System (VEIS) prototype will be delivered to the government. The VEIS is a management system designed to improve the management and exchange of engineering information within and between the defense industry's engineering systems design and user operations. The overall objective is to reduce engineering product costs through the effective management and exchange of data. Radiation hardening work for Phase 2 submicrometer circuits and inhouse test and evaluation of VHSIC chips will be completed. Part 1 of the qualification program will be completed with the addition of several VHSIC devices and a VHSIC gate array family to the military qualified parts list. Testing and verification of generic qualification procedures (part 2 in the qualification program) will be completed. These new procedures will make the qualification requirements more efficient and responsive to the government's need for complex military application of specific parts. Funding estimates are based on detailed program planning and analysis performed by Service experts in such disciplines as design automation, manufacturing reliability and testing. The results from contract pricing, for efforts now in progress, also assist in developing funding estimates.

(4) (U) Program to Completion: Not applicable.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603601F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Conventional Weapons
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 27,984 | 11,552 | 25,301 | Continuing | N/A |
| 670A | Ordnance Technology | 16,946 | 6,752 | 12,301 | Continuing | N/A |
| 670B | Guidance Technology | 11,038 | 4,800 | 13,000 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Funds the advanced development and technology demonstration of advanced nonnuclear aircraft armament and weapons guidance technologies, both air-to-air and air-to-surface. New weapon concepts and technology applications are developed and tested to demonstrate feasibility, effectiveness, and operational potential. This program serves as the basis for follow-on system development and advanced prototyping programs for future munitions like conventional standoff precision guided air-to-surface weapons and less sensitive munitions which are vital to force survivability and the conventional deterrent posture of the United States.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 24,291 | 25,021 | 31,519 | Continuing | N/A |

EXPLANATION: (U) The FY 1988 reduction reflects Congressional action to consolidate Air Force and Navy air-to-air missile efforts; deletes precision guidance funding for both air-to-air and air-to-surface weapons. Program impact is to cancel Advanced Air-to-Air Processor Technology work and delay transition to full scale development for all projects within this PE. AF development of all-weather, autonomous air-to-surface precision guidance seeker systems for standoff weapons will be delayed 18 months.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program demonstrates nonnuclear technologies initially investigated in Air Force exploratory development Conventional Munitions (PE 0602602F), Aerospace Avionics (PE 0602204F) and Rocket Propulsion (PE 0602302F) programs. Coordination is maintained with Advanced Avionics for Aircraft (PE 0603202F), Digital Avionics Information System (PE 0603243F), Millimeter Wave Seekers (PE 0603609F), and NAVSTAR/Global Positioning System

(PE 0604778F) Joint programs. Outputs from this technology base program are transferred to: Advanced Medium Range Air-to-Air Missile (PE 0604314F), Millimeter Wave Seekers (PE 0603609F), Armament Ordnance Development (PE 0604602F), Submunitions (PE 0604604F), Joint Ordnance Commanders Group (JOCG) for Munitions Development, the JOCG for Munitions Effectiveness, and the Surface Defense Suppression (PE 0604733F) programs. Tri-Service coordination is accomplished through the Joint Service Guidance and Control Committee and other joint specialized committees which have been formed for specific technology sub-areas. International cooperation and coordination is under the auspices of The Technical Cooperation Program (TTCP) and various specific country-to-country data exchange agreements, such as the NATO programs for infrared and millimeter wave target/background signature measurements.

6. (U) WORK PERFORMED BY: The Air Force Armament Laboratory, Eglin Air Force Base FL, is the responsible technical activity for this program. Test facilities at the Armament Division, Eglin Air Force Base FL; the Arnold Engineering Development Center, Arnold Air Force Station TN; and the Naval Weapons Center, China Lake CA, support this program. Major contractors on this program are: Raytheon, Bedford MA (670B); Texas Instruments, Dallas TX (670B); Goodyear Aerospace Corporation, Phoenix AZ (670B); and General Electric Co., Burlington VT (670A). Twenty-two other contractors and non-Air Force Government activities hold additional contracts valued at approximately $44 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 670A, Ordnance Technology

A. (U) Project Description: Technology base effort to develop and demonstrate the feasibility, effectiveness and operational value of conventional nonnuclear ordnance technologies for air-to-air and, principally, air-to-surface weapons. Project includes ordnance technologies for fuzes, hard target warheads, insensitive and less sensitive explosives, bombs, submunitions and their dispensing mechanisms, advanced guns and ammunition, air-to-surface composite weapon frames, and weapon ordnance subsystems integration. Objectives include effective airfield denial, increased munitions and transportation safety and increased on-base ordnance storage through qualification of insensitive high explosives combined with mechanical deterrents to bomb-to-bomb sympathetic detonation, increased operational effectiveness against buried and hardened targets, increased aircraft gun effectiveness, hard target defeat, multiple kills per pass, more effective submunition dispensing, low cost manufacturing techniques, low drag composite weapon airframes, and increased operational flexibility.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Initiated ground prototype demonstration of the advanced aircraft gun and ammunition. A prototype gun and ammunition capable of demonstrating the high muzzle velocities needed for longer range

effectiveness and increased aspect gunnery capability were fabricated. Continued development of hard target weapon technologies. Continued evaluation and analysis of advanced fuzing and penetrating warhead designs. Fuze designs were evaluated to establish their performance and payoff potential to defeat complex underground targets. Similarly, candidate designs for a penetrator warhead capable of effectively defeating complex underground targets were evaluated. Continued development of insensitive munitions technologies including a Desensitized High Explosive (DHE) and Insensitive High Explosive (IHE) formulation for use in general purpose bombs. Incorporation of either a DHE or an IHE in bombs will enhance munitions transportation and handling safety and relieve severe on-base storage problems faced in both European and Pacific theaters and will provide increased tactical operational survivability and flexibility. Continued efforts to integrate and demonstrate advanced air-to-surface dispenser weapon airframes, high speed submunitions, and conformal carriage and release technologies. Efforts were concentrated on applying low cost manufacturing techniques in the brassboard fabrication of weapon airframe hardware.

(2) (U) FY 1988 Program: Continue ground demonstration of an advanced, flight weight aircraft gun and its associated telescoped ammunition. This gun will provide muzzle velocities 50% greater than our current M-61 gun system, leading to greater lethality, longer effective range, and an increased aspect capability in air-to-air engagements. It will also provide enhanced capability for gunship operations through increased standoff range. Complete the transition of a DHE formulation into general purpose bombs. Initiate development and initial screening of IHE candidate formulations for use in missiles and submunitions. The incorporation of DHE and/or IHE in our ordnance will reduce munitions storage quantity-distance (Q-D) criteria limitations in overseas theaters. Continue development of hard target ordnance technologies. Fabricate and test the brassboard fuze and warhead components and evaluate options for an integrated ordnance package. This effort will provide a demonstrated capability to defeat underground hardened targets currently vulnerable only to nuclear attack. Continue ground test and evaluation of an advanced dispenser weapons airframe configuration. This advanced weapons airframe effort will provide a demonstrated technique for the low cost manufacture of a low drag dispenser airframe capable of being carried on future aircraft without measurably degrading aircraft performance.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete ground demonstration of an advanced aircraft gun and associated telescoped ammunition. Continue development and qualification of IHE formulations for use with missiles and submunitions. Candidate formulations will be evaluated in full-scale warhead tests. Candidate formulations meeting both the insensitivity and performance criteria will be identified for boostering and qualification testing during FY 1990. Continue development and demonstrations of hard target ordnance technology. Brassboard components demonstrated during FY 1988 will be integrated into an ordnance package and subjected to field and sled tests to evaluate component interactions/interfaces and to assess overall performance against characteristic targets. Design modifications and final performance testing will continue into FY 1990 prior to transitioning to full scale development for use in a hard target weapon. Complete development and demonstration of advanced dispenser weapon airframe designs and transition them to full scale development. This advanced dispenser airframe will incorporate advanced manufacturing techniques, composite materials advances, and low drag shaping to achieve a substantial increase

in the performance. Combined with advanced carriage techniques, it will reduce the drag penalty on the delivery aircraft. Initiate development of improved high velocity combat ammunition. Projectile fuze and warhead designs initially demonstrated in PE 0602602F, Conventional Munitions, will be used as the baseline for designing a lethal, high velocity combat ammunition that will have greater effectiveness over current aircraft gun ammunition. Initiate development of an improved counterair ordnance package which incorporates fuze and warhead technologies developed in PE 0602602F, and available warhead technology developed by the Navy and National Laboratories. This effort will provide an improved ordnance package for missiles like the Advanced Medium Range Air-to-Air Missile (AMRAAM), the Advanced Short Range Air-to-Air Missile (ASRAAM), and the Navy Advanced Air-to-Air missile. It gives 200-300% greater energy on target and expands the missile lethal area.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 670B, Guidance Technology

A. (U) Project Description: Technology base effort to develop and demonstrate the feasibility, effectiveness, and potential operational value of advanced midcourse and autonomous, all-weather precision terminal guidance technologies principally for air-to-surface weapons. Objectives include standoff delivery/threat avoidance through preprogrammed autonomous seeker target recognition and attack, longer range target acquisition, precision terminal guidance with increased accuracy, all-weather operation, increased tactical flexibility and survivability, automatic target classification and identification, reliable operation, and affordability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Completed Hardware-In-the-Loop (HIL) evaluation and captive flight test of the Infrared High Value Target Acquisition (IRHVTA) seeker and planned for the transition of the technology into a prototype dem/eval effort for the air-to-surface autonomous guided weapon. When mated with a standoff-capable weapon frame, this seeker will reduce delivery aircraft attrition through an increased threat avoidance capability. IRHVTA seeker will provide an affordable autonomous lock-on-after-launch guidance capability that eliminates the dependence on man-in-the loop systems like laser designators or data link pods for air-to-surface weapons while still providing precision accuracy. Initiated integration and demonstration of advanced air-to-air missile subsystems technologies; initiated designs of missile test bed and HIL simulations. Completed captive flight test of the Advanced Seeker Technology for Air-to-Air Missiles (ASTAAM) seeker at Green Flag and continued HIL test and analysis of integration of a VHSIC processor within the ASTAAM seeker called Advanced Processor Technology for Air-to-Air Missiles (APTAAM). Continued the Autonomous Synthetic Aperture Radar Guidance (ASARG) development effort. Demonstrated the technology for an active/passive Radio Frequency (RF) seeker which could benefit the Navy's Advanced Air-to-Air Missile Program.

Efforts were concentrated on laboratory test and evaluation of a brassboard guidance subsystems. Completed concept definition studies of a multi-spectral seeker for use in air defense against cruise missiles and reduced radar cross section aircraft. Results of this effort will be used as the basis for the missile seeker concept development project. Completed development of a Self Protection Weapon to provide a capability against present and future short-range radar directed air defense threats.

(2) (U) FY 1988 Program: Complete the lab test of the ASARG seeker concept. The ASARG program exploits state-of-the-art Synthetic Aperture Radar (SAR) technology to provide an improved adverse weather capability for autonomous target acquisition, classification, and tracking of air-to-surface targets. ASARG captive flight tests will be delayed due to the FY 88 Congressional funding cut. Initiate transition from PE 0602602 of the effort to design and develop a low cost tactical laser radar seeker. Efforts will focus on captive flight tests which simulate high speed, low altitude target acquisition environments. The laser radar technology complements previous imaging infrared seeker developments by providing more accurate range information to perform target classification and identification and tracking of high value fixed and relocatable targets. This laser radar development will be specifically designed for low cost, simple pre-mission planning, standoff delivery, and near-zero CEP terminal guidance accuracy. Complete HIL test and evaluation of a VHSIC technology processor for advanced weapons.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete initial captive flight tests of the ASARG concept seeker. The ASARG technology provides an adverse weather, autonomous target acquisition and attack capability against both fixed and mobile ground targets. This technology will transition to full scale development in FY 1992 for use with the hard target weapon and/or as a product improvement to other standoff air-to-surface weapons. Continue ground test and begin captive flight test of the low cost tactical laser radar seeker. Laser radar ranging provides the seeker capability in low contrast conditions, allowing greater flexibility in employment. The seeker is to be provided as an improvement to existing and developmental weapons to allow standoff, precision attack without sacrificing affordability.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

10. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603605F
DOD Mission Area: 554 - Directed Energy Technology (ATD)
Title: Advanced Radiation Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 39,088 | 71,650 | 74,494 | Continuing | N/A |
| 3150 | Laser Device Technology | 1,041 | 0* | 0 | * | * |
| 3150 | High Energy Laser Technology | 0 | 2,758 | 1,926 | Continuing | N/A |
| 3151 | Optics & Beam Control Technology | 21,541 | 0* | 0 | * | * |
| 3151 | PILOT | 0 | 16,242 | 19,500 | Continuing | N/A |
| 3152 | Technology Development Support | 500 | 0* | 0 | * | * |
| 3152 | High Power Microwave Technology | 0 | 6,000 | 6,228 | Continuing | N/A |
| 3647 | Ground Based Laser Technology** | 16,006 | 46,650 | 46,840 | Continuing | N/A |

* Beginning in FY 1988, these three projects have been retitled and the content rearranged.
** This project was transferred from PE 0604406F, Space Defense Systems in FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the only Air Force science and technology program which develops and demonstrates directed energy (DE) technologies for Air Force applications. Major technology breakthroughs in high power laser devices, coherent diode laser arrays, high power microwaves, and nonlinear optics have been demonstrated. This program develops, demonstrates, and integrates these DE technologies for applications, such as a ground based laser antisatellite weapon, a high power microwave weapon, or a near-term low-power laser diode array spinoff. To develop these technologies, this program (1) establishes the DE concept effectiveness; (2) scales the technology to the required intensity levels; (3) explores options to reduce the weapon system size and weight; and (4) investigates concepts to significantly improve reliability and reduce acquisition time and costs. The efforts in this program do not duplicate tasks being conducted under the Strategic Defense Initiative.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 23,641 | 29,076 | 34,766 | Continuing | N/A |

EXPLANATION: (U) The FY 1989 amount accomodates reductions in Air Force Total Obligation Authority. Project 3647, Ground Based Laser Technology, was transferred from PE 64606F, Space Defense Systems, in FY 1987.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This PE is part of the tactical directed energy weapon program coordinated by the Director for Military Systems Technology in the office of the Under Secretary of Defense for Research and Engineering. Related work is in: Air Force PE 0602601F, Advanced Weapons, project 3326, Laser Applications and project 5797, Advanced Weapons; PE 0603250F, Lincoln Laboratory; Army PE 0602307A, Laser Weapon Technology; and Navy PE 0602101N, Directed Energy Weapons. Work in this PE is coordinated extensively with the Strategic Defense Initiatives Program PE 0603221C, Directed Energy Weapons. All high energy laser technology in PE 0603221C is closely monitored and the technology with tactical applications is factored into developments in PE 0603605F. The ground based laser project is coordinated with PE 0604406F, Space Defense Systems. Coordination with the Department of Energy is through laboratory technical program reviews, exchange of technical reports, and cooperative efforts at the working level. The high power microwave effort is also coordinated closely with the following Air Force PEs: 0602202F, Human Systems Technology; 0602204F, Aerospace Avionics; 0603718F, Electronic Warfare Technology; 0603749F, Command, Control, and Communications Countermeasures Advanced Systems; 0604711F, Systems Survivability (Nuclear Effects); and 0604747F, Electromagnetic Radiation Test Facilities. High Power Microwave technologies are also being explored in close cooperation with a number of non-Air Force agencies. These include the Army, Navy, and three of the national laboratories.

6. (U) WORK PERFORMED BY: The Air Force Weapons Laboratory, Kirtland Air Force Base, NM, manages this program. The top five contractors are: McDonnell Douglas, St Louis, MO (3151); General Electric Astronautics Co, Valley Forge, PA (3151); AVCO Everett Research Laboratory, Everett, MA (3647); Rockwell Power Service Co, Albuquerque, NM (3150, 3151, and 3647) and David Sarnoff Research Center, Princeton, NJ (3151). There are 19 additional contractors with contracts totaling $13.2 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3150, High Energy laser Technology. This project, prior to FY 1988, concentrated solely on the development of photon generating laser devices. For FY 1988 and beyond, optics and beam control concepts (e.g. nonlinear optics and optical phased arrays) for these devices transferred into this project from Project 3151. During FY 1987, the chemical oxygen-iodine laser (COIL), a near-infrared wavelength device, was successfully demonstrated with a power output of 25 kilowatts. Beginning in FY 1988, the COIL is one of the candidate lasers for Project 3647, Ground Based Laser Technology, where further development and testing of the COIL will be conducted. For FY 1988 and beyond, Project 3150 concentrates on two technology areas: nonlinear optics (NLO) and phased array imaging. The most promising NLO techniques used with near-infrared wavelength chemical lasers transitioned from PE 0602601F in FY 1988. These technologies use NLO materials to correct nonuniformities and to facilitate combining and pointing multiple high energy laser beams. In FY 1988, an NLO pointing and tracking brassboard will be fabricated and then tested in FY 1989. Investigations of phased array telescopes will continue with an imaging demonstration using four telescopes in FY 1988 and an image sharpening demonstration in FY 1989 using atmospheric disturbance cancellation. Phased array telescopes offer great promise for both high power beam projection and high resolution imagery because of the ability to use small, low cost, off-the-shelf telescopes and avoid dependence upon a single laser device.

B. Project: 3152, High Power Microwave Technology. Starting in FY 1988, this project supports the development of high power microwave (HPM) technologies. In FY 1987, it supported the two laser technology development projects. It established and operated special experimental laser facilities and provided advanced laser diagnostic instrumentation. The optical fabrication and evaluation facilities were upgraded to provide a capability at visible and near-infrared wavelengths. In FY 1988, these efforts transferred to project 3150, High Energy Laser Technology. In FY 1988, this project's objective is to develop the technologies and a susceptibility data base that will (1) identify potential vulnerabilities of select United States weapon systems to HPM

This objective will be accomplished by testing select representative systems and subsystems in a variety of radio frequency (RF) environments to determine their susceptibilities for a spectrum of RF parameters. These tests will provide an understanding of the effects of multiple pulses at high power levels on systems and how these effects scale relative to the single pulse data. A series of increasingly complex tests is are planned, culminating in full-scale tests as the required HPM test facilities become operational. These tests will measure the susceptibilities of select systems to threat level RF signals

They will require a laboratory RF source and associated test facilities that can produce the desired electric field environment and can properly diagnose this environment and the response of the weapon system to the RF radiation. In FY 1988, repetitively pulsed power driver and associated high power RF device(s), designed and developed under PE 62601F, Advanced Weapons, will be used to conduct a series of effects tests on unhardened operational US systems/subsystems. These unhardened assets will include the AIM-7M, infrared (IR) Maverick missile systems, and the M-1 Abrams Tank.

In FY 1989 effects testing of unhardened systems/subsystems, such as the AWG-9 infrared search and tracking system and IR Maverick missiles, will continue. These tests will be performed with a repetitively pulsed, high power source developed under this PE from oscillator technology originally developed under PE 62601F. Simple hardware changes will allow variations in frequency, pulse width, and power output.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3151, Phased Integrated Laser Optics Technology (PILOT)

A. Project Description: PILOT is a

This project investigates and demonstrates the practicallity of

With advanced semiconductor growth/processing technology it should be possible to

During FY 1987, this project also developed other optical technologies, but shifted to only PILOT in FY 1988.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: The essential feasibility of the PILOT concept was successfully demonstrated with the fabrication and initial testing of

Preliminary results from two different contractual efforts, employing different technical approaches, have shown the ability to produce

Substantial progress has also been made in the detailed understanding of

and in the definition of approaches for

Alternate technology investigations were also initiated, considering

with substantial payoff in long-term system applications. A preliminary analysis focused on long-term applications to help direct technology development efforts. A subsequent applications analysis effort, begun in late FY 1987, investigates specific near-term applications of PILOT technology with the goal of identifying specific technology transition opportunities. One area of clear near-term payoff is laser communications. PILOT technology for this application transitioned to a preliminary design for a specific system in FY 1987. Other efforts (which transferred to Project 3150 in FY 1988) concentrated on high payoff laser components and concepts. This included multiple phased array telescope imaging which will allow target discrimination. An aperture sharing element was fabricated and will be tested for use in a short wavelength chemical laser. The phased array mirror technology coupled with the aperture sharing technology will allow the high power transmission system to be used for high resolution.

(2) FY 1988 Program: This project includes only PILOT for FY 1988 and beyond. Contractor test and evaluation of the first-generation developed in FY 1987, will be completed and samples of these are being delivered to the Air Force for further testing. Building upon this successful feasibility demonstration, a dual-path development program to has been initiated.

This approach, known as the

Technology Demonstrator, will fabricate [ ] The goal of the Technology Demonstrator is [ ] producing at least [ ] These [ ] are each unique in their approach and both efforts are essential to establish the [ ] for PILOT. In other efforts, the near-term applications study begun in FY 1987 will be completed, and the results will be used to identify high-payoff applications of PILOT technology. The results will also provide a basis for the advocacy of this technology to user organizations for potential transition into system development programs. Alternate technology efforts will continue, with increasing emphasis on issues [ ]

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Module Development and Technology Demonstrator efforts, begun in FY 1988 to specifically address complementary approaches to [ ] will continue. Design and concept verification experiments and analysis for both efforts will be completed, and fabrication of hardware will begin. Considerable emphasis will be placed on PILOT technology transition for near-term applications such as laser communications, building upon the results of the near-term applications studies completed in FY 1988. Depending upon user requirements, technology development efforts to meet specific applications will be initiated. Alternate technology investigations, begun in FY 1987, will be completed with the demonstration and [ ] providing a demonstration and evaluation of [ ] Initial efforts to investigate supporting technology, such as advanced thermal control techniques, will be initiated to provide the technology base required to achieve the highest performance and capability in system applications.

(4) Program to Completion: This is a continuing program. Both the Module Development and Technology Demonstrator efforts will be completed. Based upon these efforts, procurement will be started for follow-on effort will begin. This effort will combine the results of both the Module Development and Technology Demonstrator to develop and demonstrate a [ ] The initial design of a system [ ] with demonstration planned in [ ] Additionally a brassboard module will be designed and fabricated to incorporate the beam control architectures and components developed under previous efforts. Technology transition will continue.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) ( ) [ ] | [ ] |
| (2) ( ) [ ] | [ ] |

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

A. (U) Project: 3647, Ground Based Laser Technology Development

Project Description: This project began in FY 1987 to develop and demonstrate technology needed for a to build a ground based laser antisatellite (ASAT) weapon. The goal is to develop the detailed system concepts and demonstrate the required technologies for: (1) the laser device; (2) the specific optical components; and (3) the required laser beam control technology to efficiently compensate and propagate the laser radiation through the atmosphere to a target in space. There will be two major near term demonstrations in the program: (1) laser device modules that are directly scalable to ASAT power levels; and (2)

Atmospheric compensation is the key technology. How well the various techniques, which are very wavelength dependent, work and the associated costs will greatly influence which device is the best choice for the mission. This program will concentrate on two wavelengths: near infrared, represented by chemical oxygen-iodine laser (COIL) and free electron laser (FEL); and visible, represented by repetitive pulse excimer. FEL device technology is funded solely by the Strategic Defense Initiative (SDI), COIL device technology by the Air Force, and excimer device technology jointly by both. Currently, the COIL has demonstrated the highest power and is the most mature, but it lacks the detailed system studies and design refinements of the SDI efforts on excimer and FEL. The critical optical elements are: aperture sharing elements that can transmit the short wavelength laser beam and receive radiation in the visible and long wavelength infrared (IR) bands (required since the laser telescope is used to track the target); cooled deformable mirrors that have good optical performance and have the capability to remove the optical distortions; and other high power mirrors that have low absorption, with minimal disturbances due to coolant flow within the mirror. The major issues for these components are to settle on the most promising concepts and to develop fabrication techniques for elements that can be manufactured on acceptable schedules and at affordable costs. These programs will greatly rely on SDI efforts; however, due to considerable differences (e.g. power and size) substantial modifications are required. System level design, tradeoff, and satellite vulnerability studies will define the parameters of the weapon system and examine the architecture, components, and relative costs of the three laser candidate devices.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: This project began in FY 1987 by focusing and leveraging various Air Force and SDI programs. The path for scaling up power levels continued. The Excimer Mid Range Laser Development (EMRLD) facility on White Sands Missile Range, begun under SDI funding, was completed, as was the 25 kilowatt COIL device at Kirtland AFB, NM. The development of improved oxygen and iodine generators for the COIL also began. System level design and tradeoff studies for potential systems began.

(2) FY 1988 Program: The EMRLD device fabrication continues with the completion, installation and test of the master oscillator. This system will allow low power (5 kilowatts) repetitive pulse excimer experiments. The fabrication of the power amplifier and the beam cleanup system are continuing. The existing COIL device is being optimized and has produced 35 kilowatts thus far. The COIL will be tested with a new oxygen generator concept. Studies on refined scaled COIL devices will be conducted. Fabrication of demonstration units for low distortion high power mirrors, deformable mirrors, and an aperture sharing element will begin. In the beam control area,

Studies using breakthrough technologies such as nonlinear optics and phased arrays to allow simple scaling of the systems will begin.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request:

Scaling experiments utilizing nonlinear optics and phased arrays will be completed. System concept definition studies will provide performance specifications to subsystem and component levels, facility layouts, and system configuration.

(4) Program to Completion: Testing at the EMRLD facility will be conducted in FY 1990. This facility will provide a directly scalable moderate power repetitive pulsed excimer laser. Testing of the directly scalable COIL module will be completed in FY 1990.

C. (U) Major Milestones.

| | Milestones | Dates |
|---|---|---|
| (1) | (U) Excimer Device Testing Start | FY 1988 |
| (2) | ( ) | |
| (3) | ( ) | |
| (4) | ( ) | |

10. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603707F
DOD Mission Area: 420 - Global Military Environmental Support
Title: Weather Systems (Advanced Development)
Budget Activity: 2 - Adv Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 4,047 | 5,276 | 5,334 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element funds advanced development of weather systems that, when fielded, will eliminate critical shortfalls in weather support to Air Force and Army operations. The following efforts are included: (a) Battlefield Weather Observation and Forecast System: The Air Force critically needs the ability to observe and collect essential weather information in battle areas not under friendly control. Employment of precision guided munitions requires specific environmental information which is unique to the weapon's sensing systems and which is not available through today's weather observing and forecasting techniques. This program develops methods to gather this vital weather information and process it for use by battle staff planners and aircrews in the effective battlefield employment of precision guided munitions. It provides a key to optimizing force effectiveness during adverse weather conditions. (b) Algorithm Development for Next Generation Weather Radar (NEXRAD): This work supports the development of a Doppler weather radar capability. Timely warning for specific severe weather events is required to protect Air Force assets. Doppler weather radar provides the ability to detect severe weather phenomena. Automated analysis techniques are required to process this information in a timely manner to provide effective warning. This program provides joint Department of Defense, Department of Transportation, and Department of Commerce NEXRAD development. (c) Automated Weather Distribution System-Automated Observation Subsystem: The Air Force has a need to automatically sense, collect, disseminate and display the local weather conditions in real time to air traffic control facilities and operational units. Several key weather elements -- clouds, visibility, and present weather/obstruction to vision -- cannot be automatically sensed with current technology. This program develops the technology to automatically sense these critical weather parameters. When fielded, this program will provide real-time alerting of key weather events and may reduce weather support manpower requirements. (d) Technology Transition: The Air Force has the need to improve weather support to keep pace with the support requirements and environmental sensitivities of emerging technologies in new weapon systems. This program transitions improved and new support techniques from technology development into operational support software. Techniques within this program include: improved vertical atmospheric analysis, improved cloud analysis and forecasting, a new magnetospheric model, and an improved ionospheric forecast model.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 3,187 | 5,276 | 5,838 | Continuing | N/A |

EXPLANATION: (U) Funds were added in FY 1987 to meet the full requirement for development of battlefield weather forecast techniques, as well as the development of Doppler weather radar algorithms. FY 1989 funding decreased to meet budgetary constraints; start of algorithm validation for improved stratospheric and neutral density models is delayed from FY 1989 to FY 1990.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Results of advanced development efforts in this program element are implemented through Program Element 0604707F, Weather Systems (Engineering Development) and Program Element 0305111F, Weather Service (Other Procurement). Specifically, results of the Battlefield Weather Observation and Forecast System (BWOFS) and the Automated Weather Distribution System-Automated Observation Subsystem (AWDS-AOS) will undergo engineering development in PE 0604707F. The Next Generation Weather Radar (NEXRAD) development (PE 0604707F) will directly use automated severe weather forecast techniques developed in this program element. The 1986 Science and Technology Program Review to the Under Secretary of Defense for Research and Engineering provided a forum for tri-service coordination of efforts in battlefield forecasting techniques. The Department of Defense Atmospheric Transmission Plan is the focal point for support of precision guided munitions delivery. Working level contact with the Army and Navy continues, avoiding unnecessary parallel development of techniques and systems.

6. (U) WORK PERFORMED BY: Program management is provided by the Air Force Geophysics Laboratory (AFGL), Hanscom AFB, MA. The BWOFS program has program participation by Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH. Principal contractors are ST Systems Corporation, Lanham, MD; Dynamics Research Corporation, Wilmington, MA; Lockheed Missiles and Space Company, Incorporated, Huntsville, AL; and Georgia Technical Research Institute, Atlanta, GA. AWDS-AOS development contracts are with the University of California at San Diego, the University of Washington, and HSS Incorporated, Bedford, MA. The NEXRAD contract is with ST Systems Corporation, Lanham, MD.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0603707F, Weather Systems (Advanced Development)

A. (U) Project Description: BWOFS: Develops the ability to acquire and process weather information required by battle commanders and pilots to employ precision guided munitions effectively. The Air Force has no capability to gather or process tactical environmental information in denied areas, yet this information is critical to the effectiveness of today's high technology weapons. Algorithm Development for NEXRAD: Develops a set of Doppler weather radar diagnostic algorithms for the automated and early detection and warning of severe storm related wind and precipitation related threats to Air Force operations and facilities. These techniques will meet the operational requirements of the forthcoming NEXRAD system. AWDS-AOS: Develops the technology to automatically sense critical weather parameters and provide real-time alerting of key weather events. Technology Transition: Validates new environmental analysis and prediction techniques for operational use to meet evolving support requirements of modern Air Force weapon systems. The program includes both meteorological and space environmental analysis and forecasting methods.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Battlefield Weather Observation and Forecast System (BWOFS): A microcomputer version of Tactical Decision Aids (TDAs) for infrared (IR), television (TV), low-light level TV, and laser designator systems was developed, tested and fielded. Development of TDAs for Night Vision Goggles and Navigation Systems continued. The software architecture to support an automated composite TDA was developed. The composite TDA will combine all TDAs into one package to facilitate multi-weapon systems employment planning. The prototype weather observation sensors for the Unmanned Air Reconnaissance System (UARS) began system concept validation. Algorithm Development for Next Generation Weather Radar (NEXRAD): Preplanned algorithm improvements were developed to enhance detection and analysis of thunderstorm downbursts. Automated Weather Distribution System-Automated Observation Subsystem (AWDS-AOS): Integration of off-the-shelf meteorological sensor technology (e.g., lightning detection system) and development of additional new sensors for visibility and present weather continued. Technology Transition: An improved Proton Prediction System to correct the current deficiencies in predicting very high energy protons arriving at the earth was fielded.

(2) (U) FY 1988 Program: BWOFS: Key high value target models will be added to the IR TDA. Night Vision Goggles and Navigation Systems TDAs will be fielded. The composite TDA for standard Air Force microcomputers will be fielded. Concept validation of the UARS weather observation sensor package will continue. Algorithm Development for NEXRAD: Preplanned algorithm improvements for tropical storms, hail, tornadoes, wind shear, and turbulence will be developed. A precipitation prediction algorithm will be completed. AWDS-AOS: Development of visibility and cloud cover sensors will continue. A prototype sensor for present weather will be selected. A lightning detection/location system will be evaluated. Technology Transition: Validation of improved vertical atmospheric analysis techniques for temperature, pressure, water vapor, aerosol size distribution and density, as well as surface visibility will begin. Operational testing of improved cloud analysis and forecasting techniques will begin.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: BWOFS: Additional sensors, targets, and backgrounds will be incorporated in the Infrared TDA to significantly increase its applicability worldwide. Concept validation of the weather observation sensor package for the Unmanned Air Reconnaissance System will be completed. This sensor effort will transition to engineering development. Algorithm Development for NEXRAD: The development of preplanned algorithm improvements for severe weather detection will continue. AWDS-AOS: The automated visibility sensor development will continue with emphasis on algorithm improvement and adverse weather operation. The cloud sensor design effort will be completed and a contract for a prototype automated cloud sensor will be initiated. Technology Transition: Operational testing of improved vertical atmospheric analysis techniques will begin. Validation of algorithms for an improved ionospheric model will begin. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of the cost estimate was completed in July 1987.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | BWOFS | Program Initiation | October 1980 |
| (2) | (U) | NEXRAD | Program Initiation | October 1980 |
| (3) | (U) | BWOFS | Infrared Tactical Decision Aid (TDA) Operational | October 1983 |
| (4) | (U) | AWDS-AOS | Program Initiation | October 1983 |
| (5) | (U) | BWOFS | Development of TV and 1.06 Micron Laser TDAs Fielded | June 1984 |
| (6) | (U) | NEXRAD | Initial Algorithms Delivered to Joint Program Office | July 1985 |
| (7) | (U) | BWOFS | Observation Subsystem Sensors Testing Complete | September 1985 |
| (8) | (U) | AWDS-AOS | Initial Prototype Sensor Contract Award | September 1985 |
| (9) | (U) | Tech Transition | Proton Prediction System Development Complete | December 1987 |
| (10) | (U) | BWOFS | Composite TDA Advanced Development Complete | September 1987 |
| (11) | (U) | AWDS-AOS | Selection of Lightning Prototype Sensor | December 1987 |
| (12) | (U) | BWOFS | Integrated TDA for Standard AF Microcomputers | December 1987 |
| (13) | (U) | BWOFS | Upgraded TDAs for Infrared and Laser Systems Fielded | December 1987 |
| (14) | (U) | BWOFS | Night Vision Goggles and Navigation Systems TDAs Operational | August 1988 |
| (15) | (U) | AWDS-AOS | Selection of Present Weather Prototype Sensor | September 1988 |
| (16) | (U) | BWOFS | Observing System Testing Complete | March 1989 |
| (17) | (U) | NEXRAD | Upgraded Algorithms for Hail, Tornadoes, Wind Shear, and Turbulence Complete | September 1989 |
| (18) | (U) | NEXRAD | Initial Operations Capability Including Algorithms | September 1989 |
| (19) | (U) | AWDS-AOS | Automated Prevailing Visibility Prototype Sensor Complete | September 1990 |

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603723F Title: Civil and Environmental Engineering Technology
DOD Mission Area: 553 - Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 7,803 | 11,827 | 9,014 | Continuing | N/A |
| 2103 | Environmental Quality Technology | 1,769 | 1,801 | 1,806 | Continuing | N/A |
| 2104 | Civil Engineering Technology | 3,714 | 7,249 | 4,942 | Continuing | N/A |
| 2672 | Special Terrestrial Power | 250 | 0 | 0 | 0 | 1,975 |
| 3037 | Noise and Sonic Boom Impact Technology | 1,543 | 2,777 | 2,266 | Continuing | N/A |
| 3139 | Alaskan/Remote Site Fuel Cell | 527 | 0 | 0 | 0 | 6,025 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science & Technology program provides the technology to speed the recovery of an airbase after an enemy attack, to reduce the operating and maintenance costs of an airbase, and to minimize the environmental impact from Air Force operations. These goals are achieved through advanced research to: develop survivable air base structures and expedient facility and utility repair techniques; optimize runway pavement maintenance and recycling techniques; develop fire fighting agents and equipment; reduce Air Force pollutant emissions; correct environmental problems discovered during weapon system development; reduce the cost and amount of hazardous waste disposal; and assess and predict the noise and sonic boom impacts from aircraft operations.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 13,318 | 11,342 | 11,324 | Continuing | N/A |

EXPLANATION: (U) The change in FY 1987 resulted from the termination of projects 2672 and 3139. The FY 1988 and FY 1989 changes resulted from adjustments to the Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The efforts within this program are of significant interest to the other services and are coordinated through the Joint Services Civil Engineering Research and Development Coordinating Group to prevent duplication and to maximize technology transfer. All Air Force efforts in environmental quality R&D are reviewed annually by the Office of the Under Secretary of Defense for Research and Engineering to preclude duplication within the military services and between the services and other agencies. The Air Force is the lead service for sonic boom issues. Efforts

of civilian or national interest are coordinated with the Federal Aviation Administration, National Aeronautics and Space Administration, Environmental Protection Agency, and the National Academy of Science. The Air Force and the Navy have a memorandum of agreement to conduct joint programs for aircraft fire suppression and crash rescue. This program funds efforts that transition into PE 0604708F, Other Operational Equipment, and PE 0604617F, Air Base Survivability and Recovery. Additionally, PE 0602206F, Civil Engineering and Environmental Quality, funds exploratory development in environmental quality and civil engineering technology; and PE 0602202F, Human Systems Technology, funds exploratory development of technology to determine aircraft noise and sonic boom effects.

6. (U) WORK PERFORMED BY: In-house and contractual efforts are conducted by the Engineering and Services Laboratory, Air Force Engineering and Services Center, Tyndall AFB, FL; and Human Systems Division, Brooks AFB, TX. Other government resources are used, including those of the Departments of the Army, Navy, and Energy, the Bureau of Mines, Oak Ridge National Laboratory, the Environmental Protection Agency, the National Aeronautics and Space Administration, and the Federal Aviation Administration. The top five contractors and associated projects are Applied Research Associates, Albuquerque, NM (2104); Battelle Columbus Laboratories, Columbus, OH (2103); New Mexico Engineering Research Institute, Albuquerque, NM (2104); S Cubed, LaJolla CA (2103); and Dynamac Corp., Rockville, MD (2103 & 3037). There are 23 other contractors with a total dollar value of $8.5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2103, Environmental Quality Technology. This project develops advanced technologies and validates procedures for solving problems of environmental restoration, weapon systems emissions, industrial waste treatment, and toxic pollutant releases from Air Force operations. Increasingly stringent environmental laws require Air Force weapon systems and support operations to comply with numerous environmental considerations. Mission accomplishment can be impaired or stopped if the Air Force doesn't meet the regulatory standards. The technologies tested and evaluated in this project enable the Air Force to comply with environmental regulations. FY 1987 Accomplishments. The following work was completed: field tests of a stand-off sensor to detect hazardous chemical emissions from waste sites, thus reducing the risk to monitoring personnel; and the integration of two computer models to predict the atmospheric concentration of components formed when jet fuel is released into the air. The following work was initiated: development of a model to predict the atmospheric dispersion of toxic chemicals resulting from an explosion of a rocket during launch; and a joint study with the Environmental Protection Agency to test technologies to minimize the amount of hazardous chemicals emitted to the atmosphere from Air Force maintenance operations. FY 1988 Program. The following will be completed: development of a waste minimization method to separate paint residue from the plastic pellets that blast the paint off of an aircraft during major overhauls; and the development of a procedure to validate future toxic gas dispersion models. The following will be initiated: development of an instrument for the real-time measurement of soot particles from jet engine exhaust; studies to reduce the emission of corrosive hydrochloric acid generated during the launch of Titan rockets; tests of a hazardous waste minimization technique in which a hazardous material (cadmium) is replaced by a safer one (aluminum) in the process that protects aircraft components from corrosion; tests of treatment technologies for the disposal of new liquid and solid rocket fuels; and testing of a technique to verify that a hazardous chemical can be safely incinerated, thereby decreasing the cost of monitoring the incinerator exhaust. FY 1989 Planned Program. The following will be completed: development of a model to predict the atmospheric concentration of emissions

from disposing of solid rocket fuel by open burning; an evaluation of a field test kit to allow recycling of aircraft component cleaning solvents; an environmental assessment of a new suppressant foam for missile fuel fires; and testing of a device that directly samples and identifies the individual hazardous chemicals in a multiple chemical environment. The following will be initiated: field tests of methods to reduce the volume of hazardous wastes generated from testing bullets containing depleted uranium; a study of the environmental hazard of composite material fibers released from aircraft maintenance; and development of a model to predict the dispersion of accidental releases of toxic chemicals used in high-powered lasers.

B. (U) Project: 2104, Civil Engineering Technology. This project develops advanced technologies and validates procedures to build survivable facilities, construct and repair runways, and fight aircraft and post-attack fires. Facility and utility research allows critical base structures, such as aircraft shelters and power stations, to survive conventional weapon attacks. Recent readiness exercises showed that airbase utility (power) systems are particularly vulnerable and are difficult, if not impossible, to repair expediently. Airfield pavement development helps reduce the $100 million annual cost of maintaining Air Force runways and pavements, 92% of which now exceed their original 20 year design life. Fire technology supports over 13,000 Air Force fire fighters by improving the capability to put out fires in military-specific situations, such as in the presence of munitions or chemical warfare agents. FY 1987 Accomplishments. Field tests were conducted to evaluate the rutting of asphalt pavement caused by high pressure aircraft tires (initial estimates show a loaded F-15C/D aircraft reduces the life of asphalt pavement by 50 percent). The following were initiated: development of an expedient repair capability using new methods and materials for post-attack recovery of utilities; tests to determine safe personnel exposure limits to halon (a fire suppressant) in order to prevent accidental injury to firefighters during training exercises; simplification of a generic airbase post-attack prediction model to adapt it to specific airbase layouts with base-specific threats (enhancing the current capability for post-attack recovery); and a study of the reaction of structures built on pilings to the forces from nearby explosions (most aircraft shelters in the Pacific are built on pilings due to high water tables and unstable subsoils); and development of a procedure that allows field engineers to assess the ability of various existing pavements to support contingency operations at forward deployed areas. FY 1988 Program. The following will be completed: development of blast absorbing systems that protect existing facilities at costs less than systems currently used; and development of an aircraft fire sentry that detects and suppresses fires in storage areas of parked cargo aircraft. The following will be initiated: a study of the improved performance of pavements reinforced with fibers; a study of additives to improve the performance of asphalt (reduce the wear from thrust-vectored engines and reduce the pavement rutting from high pressure aircraft tires); and the design of add-on armor to protect fire fighting equipment from damage during post-attack operations (the loss of even one fire truck seriously slows a base's recovery). FY 1989 Planned Program. The following will be completed: investigation of steel, polypropylene, and other materials as pavement reinforcements to reduce rutting and cracking; studies of the survivability and repair of utilities; and development of an advanced aircraft rescue vehicle that allows fire fighters to reach aircraft that crash on unprepared surfaces adjacent to pavement (current trucks bog down). The following will be initiated: development of pavements that resist heat from thrust-vectored jet engine exhausts; development of a mobile air conditioning unit that quickly cools large, vital base facilities, such as avionics repair shops or computer centers (existing emergency units are designed to cool aircraft, not facilities); and field validation of an analytical model that predicts the rutting of asphalt due to high pressure tires.

C. (U) Project: 3037, Noise and Sonic Boom Impact Technology. This project develops an assessment and prediction capability to evaluate environmental impacts on humans, animals, and structures of noise from subsonic and supersonic aircraft operations. The military has the unique requirement to fly aircraft at high subsonic speeds at low altitudes, and at supersonic speeds at any altitude. To meet this requirement, air bases, training routes, and operating areas must be assessed for potential environmental impaots. A typical noise assessment currently takes from two to five years to accomplish because of the lack of scientifically credible data and methodologies to quantitatively address the impacts. Improving this capability is essential in order to prepare accurate environmental impact statements, reduce the effects of aircraft noise, and respond to public concerns in a responsible and timely fashion. The Air Force is the lead service for conducting noise research to enable full compliance with the National Environmental Protection Act. FY 1987 Accomplishments. A sonic boom prediction model was expanded to include additional combat scenarios of fighter aircraft and data from instrumented military operating areas. The model predicts the sound overpressures and distribution of sonic booms in existing or proposed supersonic airspaces. A monitoring program was conducted to determine the long-term effects of noise on an archeological site under a strategic aircraft training route. Initial results indicate there were no detrimental effects to the site. Sonic boom recorders were developed and field tested for use as unattended boom monitors. The recorders dramatically increase the amount and quality of data while cutting manpower requirements in half. The development of a storage and retrieval system for noise effects information used by environmental planners was started. Data from previous aircraft noise research on humans and animals is included in the information system. Existing models that predict the reactions of conventional structures to noise and sonic booms were evaluated to develop long-term prediction methodology for given noise and sonic boom loadings. FY 1988 Program. The sonic boom prediction model will be transitioned to environmental planners for use in noise assessments. The model will predict the effects of single aircraft missions, an improvement to the previous capability of only calculating the effects of cumulative aircraft missions. The information storage and retrieval system will be provided to environmental planners for critical evaluation. The system will relate predicted overpressures to effects on humans, animals, and conventional structures. A methodology will be developed that addresses the sonic boom impact on nonconventional soils and structures (that are areas of concern in current environmental impact assessments) such as avalanche-prone areas and national monuments. FY 1989 Planned Program. A method will be developed to determine the effectiveness of on-base jet engine noise suppression systems. Currently, no objective criteria exist for determining the ability to reduce the noise impacts on the base population or the surrounding civilian community. Environmental planning methods will be integrated with the noise information retrieval system to estimate noise impacts even with limited site data, allowing environmental planners to focus quickly on the specific types of assessments needed for their particular situations.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603726F
DOD Mission Area: 345 - Tactical Communications

Title: Command, Control, Communications, and Intelligence
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 2,714 | 5,220 | 8,026 | Continuing | N/A |
| 2478 | Tactical $C^3$ Architecture | 0 | 92 | 554 | Continuing | N/A |
| 2810 | Digital Mapping/Charting | 0 | 1,253 | 1 422 | Continuing | N/A |
| 2863 | Fiber Optics Development | 2,714 | 3,400 | 3,730 | Continuing | N/A |
| 3192 | Tactical Optical Disk | 0 | 475 | 2,320 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The mobile elements of the Tactical Air Control System (TACS) must be capable of separating their associated operations centers away from radio frequency (RF) emitters to maximize survivability and operational flexibility. Also, the weight, cost and bulk restrictions of present interconnecting cable systems cause significant degradation to the mobility and flexibility of tactical systems. Fiber optics have been demonstrated to provide substantial increases in remoting distances for RF emitters with greatly reduced weight and cost. A further benefit is the reduction in bulk of the extensive cabling associated with TACS elements. This program provides the advance development of fiber optics systems designed to meet these requirements. Also included is the definition of standards to provide interoperability between Air Force systems and the systems of the other Services, and to prevent the proliferation of nonstandard equipment. The Tactical Optical Disk System (TODS) project will accommodate multi-sensor inputs to intelligence exploitation systems. The Cartographic Applications for Tactical and Strategic Systems (CATSS) project will provide digitized data bases needed for navigation, targeting and weapons delivery functions of current and future weapons systems. This effort complements but does not duplicate efforts at the Defense Mapping Agency and allows them to concentrate on development efforts to refine terrain coverage and to maintain/up-date world-wide navigational features.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 6,368 | 8,608 | 9,634 | Continuing | N/A |

EXPLANATION: (U) - THE FY 1988 decrease is due to a Congressional reduction. The FY 1989 reduction accommodates decreases in Air Force total obligational authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The efforts in this program element include transition of technology developed under PE 0602702F, Command, Control, and Communications and from PE 0603728F, advanced computer technology. Efforts within the Air Force are coordinated by the Air Force Fiber Optics Working Group. Coordination between the Services is through the tri-Service Fiber Optic Coordinating Group. Systems for tactical communications will be transitioned to PE 0208010F, Joint Tactical Communications for full scale development.

6. (U) WORK PERFORMED BY: Air Force Systems Command manages this program through Rome Air Development Center, Griffiss AFB, NY. The current contractors are: GTE Sylvania, Needham, MA, (Tactical Generic Cable Replacement (TGCR)); TRW, El Segundo, CA, (TGCR); RCA, Camden, NJ, (standard family of transceivers); Harris Corporation, Melbourne, FL and PAR Technology, New Hartford, NY (data base structures); Grumman Data Systems Corporation, Woodbury, NY and Illinois Institute of Technology Research Institute, Chicago, IL (functional software definition and sensitivity modeling); Sundstrand Data Control, Redmond, WA (Tactical Optical Disk System); Hughes Aircraft Company, Los Angeles, CA, (intrusion resistant fiber optics); ITT, Nutley, NJ (radar remoting applique).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2863, Fiber Optics Development: The Tactical Generic Cable Replacement (TGCR) system will replace all 26 pair copper cable with fiber optics. This development is a joint effort with the U.S. Army. The TGCR senses the electronic interface on each of 26 pairs, converts the signal to light, and communicates over 6 kilometers of optical fiber. The standardized family of optical transceivers will significantly reduce life cycle costs and proliferation of fiber optics based subsystems. This program is the Air Force response to the Joint Service Common Elector-Optic Module program directed by the Deputy Under Secretary of Defense for Research and Advanced Technology. A standard family of fiber optic transceivers for local area networks (LAN) will provide standardized multi-mode fiber optic systems for LANs. A Radar Remoting Applique (RRA) will extend the fiber optics remoting capability, without a repeater, of radars to 10 kilometers. This program will take advantage of wavelength division multiplex technology developed in exploratory development (PE 0602702F) to provide interoperability between existing remoting systems and to meet the full radar remoting requirements of the Tactical Air Forces (TAF). A near-term Tactical Intrusion Resistant Optical Communication System (TAC-IROCS) will build on technology developed for fixed plant application. The system will demonstrate how classified traffic can be communicated without encryption devices over optical fiber protected by intrusion sensing technology developed in this program. An advanced IROCS program will provide high bit rate, wide bandwidth protection over graded index fiber (versus lower bit rate step index fiber) and will introduce the capabilities for IROCS on bus systems with less than five ports. The Optical Multiplexer Family will provide small, low cost alternatives to large, power consumptive digital multiplexers. A multi-gigahertz analog communications program will be designed to provide waveguide alternatives at radio frequencies from 1 GHz ultimately to 60 GHz. Work continued on the Standard Family of Optical Transceivers. The RRA design phase was initiated.

In 1987, the Standard Fiber Optics Transceivers program was completed. The TAC-IROCS program will move into the hardware fabrication phase, laying the groundwork for the advanced IROCS program in FY 1988.

FY 1988 Planned Program and Basis for FY 1988 RDT&E Request is initiation of the advanced Intrusion Resistant Optical

Cable System (IROCS) program, the optical multiplexer family, and the multi-gigahertz analog communications program design. The Radar Remoting Applique, which will provide fiber optic remoting capability for AF inventory radars to 10 km, will be completed. Budgetary Category III cost estimating techniques were applied in program review by program office in August 1986.

FY 1989 Planned Program and Basis for FY 1989 RDT&E Request covers continued design of advanced Intrusion Resistant Optical Cable System (IROCS), the optical multi-plexer family, and the multi-gigahertz analog communications program. Category III Budgetary Cost - estimating techniques were applied by the program office in August 1986. This is a continuing program driven by advances in fiber optics applications/requirements.

B. (U) Project: 3192, Tactical Optical Disk System. This project transferred to this PE from PE 0603789F. The Tactical Optical Disk System (TODS) project will design, deliver and test an integrated suite of digital optical disk systems that have been ruggedized and made transportable. TODS equipment will include a 10-disk automated recorder/player, a single disk recorder/player and a desk top/rack mounted play only unit. These digital optical disks will provide the capability to improve data storage and retrieval capability, storage density and data capture rates by 2-3 orders of magnitude over present magnetic disk and tape systems. The Tactical Optical Disk System (TODS) capability is required to deal with the real time and near-real time multi-sensor inputs to intelligence exploitation systems such as the TR-1 Ground Station and Strategic Air Command (SAC) deployable $C^2$ center, the SAC Headquarters Emergency Relocation Team, and the Electronic Systems Division Advanced Deployable Digital Information Support System. In FY 1986, under Air Force exploratory Development (0602702F) funding, the basic design and development of a ruggedized optical disk system had taken place. Primary emphasis was placed on miniaturization and ruggedization of the optics. The resultant brassboard system has a 4x reduction in overall optical system size while maintaining the performance requirements of the much larger benign environment systems. The total system envelope is approximately three cubic feet or 12 vertical inches of rack space. Design studies finalizing TODS hardware configurations and performance specifications were completed in FY 1987; a contract for a 5.25 inch system was awarded. In FY 1988 the contract for a 14 inch system will be awarded. FY 1989 will conclude the build phase and begin initial flight/field testing of hardware.

C. (U) Project: 2810, Digital Mapping Charting and Geodesy Technology. This project was transferred from PE 0603259F in response to Congressional recommendation to reduce R&D line items. The Cartographic Applications for Tactical and Strategic Systems (CATSS) program will develop data base structures which support multiple Air Force systems requirements for such applications as navigation, targeting, and weapons delivery. Applications algorithms will be developed to more efficiently manipulate/transform/exploit data and develop techniques to assist users and developers to more accurately define their requirements. There will be two outputs. The first will be a single Air Force specification for its future digital cartographic data base needs. This will reduce the proliferation of system-unique data base requirements and permit significant portions of the Defense Mapping Agency's cartographic data production resources to shift into expanding the terrain coverage and away from the costly reformatting of existing data. For the Air Force, this will enhance the operational effectiveness and flexibility of new systems being fielded; e.g., cruise missiles. The second product will be a set of computer software support tools for digital cartographic data. This development will produce algorithms to take the Defense Mapping Agency's generic data base output and transform it to the data

structures needed for generic functional application and will produce techniques to compact the data to meet the limited data storage capabilities of operational systems. Delivery of these tools to weapons systems developers will eliminate the present practice of paying for duplicate contractor efforts on different programs to address functional applications. Additionally, it will allow developers to improve and verify their systems designs by using the actual Air Force data base during their experimental design phase. In FY 1987, transformation and compaction software development began. Detailed design implementation and demonstrations began in FY 1987 and will conclude in FY 1990. Interactive refinements of the detailed applications software with system developers began. The Air Force specification development for standardized digital cartographic data, started in FY 1987, will be completed in FY 1989 and transitioned to the Defense Mapping Agency (DMA) to support their master data base update. Refinements to this specification will be an ongoing effort as operational users and system developers participate in the detailed applications design demonstrations starting in FY 1989. During FY 1988, detailed design implementation and demonstrations will continue. Operational users and weapon systems developers involvement during these demonstrations will be fed back into refining the consolidated Air Force requirements specification. Transformation and compaction software development will continue. During FY 1989, demonstrations of the compaction/ coordinate transformation software development will continue and conclude in FY 1990.

D. (U) Project: 2478, Tactical Command, Control and Communications ($C^3$) Architecture. This project develops Tactical Air Force $C^3$ mission area studies in conjunction with Air Force theater tactical commands and in cooperation with the Tactical Air Force Interoperability Group. This project involves the development of road maps, task sequences, schedules, and cost estimates for the orderly and evolutionary improvement of the TACS. In FY 1987, efforts continued to refine an architecture for the future 21st Century TACS. In FY 1988 and FY 1989, efforts will also continue to refine TACS architecture. Potential development efforts stemming from Air Force Systems Command's FORECAST II study will be incorporated into TACS improvement plans.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603728F
DOD Mission Area: 551 - Electronic and Physical Sciences

Title: Advanced Computer Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 6,980 | 4,128 | 10,239 | Continuing | N/A |
| 2527 | Software Life Cycle Tools | 1,662 | 1,550 | 2,550 | Continuing | N/A |
| 2529 | Computer Architecture Applications | 153 | 483 | 1,060 | Continuing | N/A |
| 2530 | Distributed System Reliability and Survivability | 3,248 | 1,150 | 3,489 | Continuing | N/A |
| 2532 | Knowledge-Based Systems | 1,917 | 945 | 3,140 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program develops and demonstrates technologies to control cost, reduce risk, and increase efficiency and effectiveness of mission critical computers and software. The Department of Defense has experienced a dramatic escalation in costs for acquiring and supporting software for computers embedded in weapon systems. The increasing complexity of military systems coupled with the availability of smaller, more powerful computer hardware has promulgated the use of digital computers and resulted in an unprecedented demand for software. Development and support of software are labor intensive processes and their spiraling costs are a function of increased demand. In addition, the proliferation of computers in our weapon systems dictate that they be more reliable and survivable in the battlefield environment. The requirement for survivable tactical, strategic and space computing systems has driven the need for automatic integration/interoperability of multiple processing elements, automatic redistribution of data and functions, and location independent access of data. Survivability of mission critical command and control functions demands distributive processing techniques which dynamically reconfigure the assets to accommodate lost components or nodes. This program also develops distributed processing and optical processing technology for improved system power, fault tolerance, reliability and survivability. In addition, this program is the Air Force's primary focus for the development of Artificial Intelligence (AI) technology and selected applications of AI to Air Force systems.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 9,235 | 5,128 | 12,249 | Continuing | N/A |

Program Element: 0603728F
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD)

Title: Advanced Computer Technology
Budget Activity: 2 - Advanced Technology Development

EXPLANATION: (U) The FY 1987 and FY 1988 budget profiles result from reductions taken by Congressional actions. The FY 1989 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This program complements the Consolidated Department of Defense (DOD) Software Initiative, PE 0603756D, which is comprised of the following three projects: DOD Common Programming Language - Ada; Software Technology for Adaptable, Reliable Systems (STARS); and DOD Software Engineering Institute (SEI). The Ada project establishes and controls the Ada language and related DOD technical management standards. The STARS project exploits Ada software engineering opportunities and industry expertise to advance Ada software technology. The SEI project transitions state-of-the-art software engineering technology to DOD programs. Whereas the Consolidated DOD Software Initiative's primary focus is Ada-related, the Advanced Computer Technology program focuses on next generation technologies in software (e.g., knowledge-based systems, artificial intelligence, logic programming, symbolic evaluation) and hardware (e.g., distributed systems, optical processing). The combination of the Consolidated DOD Software Initiative and the Air Force's Advanced Computer Technology program provides a balanced overall program. This program receives advances in computer technology developed in the Command, Control, and Communication program (PE 0602702F) and transitions technology to the DOD Software Engineering Institute and the Computer Resource Management Technology program (PE 0604740F).

6. (U) WORK PERFORMED BY: The Rome Air Development Center, Griffiss AFB, NY, has management responsibility for this program. The five primary contractors are: Martin Marietta, Denver, CO (Project 2527); General Research Corporation, Santa Barbara, CA (Project 2527); Stanford Research Institute, Menlo Park, CA (Project 2530); Carnegie-Mellon University, Pittsburgh, PA (Project 2530); and Honeywell, Minneapolis, MN (Project 2532). There are an additional twelve contractors performing work with a total dollar value of $2.7 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2527, Software Life Cycle Tools. This project develops software engineering technology to reduce the cost and improve the quality of mission critical software in weapon systems. Efforts under this project address all phases of the software life cycle from requirements definition and specification through design, coding, test, integration, and post deployment support. The emphasis is to develop programming and management aids to increase the quality of software while reducing the cost. In FY 1987, implementation of a software engineering environment (an integrated set of methods, procedures, and computer programs that support the entire software life cycle) continued. Work also continued on the implementation of a rapid prototyping system which will enable operational users to quickly construct workable software models of selected critical system functions such as man-machine interfaces data base designs, data flows, and communication parameters. This will allow us to identify user requirement/developer interpretation errors in the software design phase where it costs 36 times less to fix the problem than in the maintenance phase where these errors are historically discovered. Another thrust of this project is to develop techniques to quantitatively measure the quality of software. These techniques are currently being automated and

will allow software quality to be specified as a deliverable item to the government during weapon system development. Also in FY 1987, the design for a software quality and productivity laboratory was initiated. This laboratory will allow for the study of the multitude of factors which affect the software development process. In FY 1988, the development of initial capabilities required for this laboratory will commence. Additionally in FY 1988, the software engineering environment (SEE) will be tailored to support the development of Command, Control, Communications and Intelligence ($C^3I$) software. The SEE will be completed in FY 1989 and the rapid prototyping system will be completed in FY 1988. Projects to be initiated in FY 1989 will define concurrent processing strategies and develop automatic programming techniques. The objective of the strategy definition work is to ensure that the full capabilities of concurrent processing are used by the programmer. The automatic programming work will greatly reduce the amount of time and labor involved with development of reusable software modules. In FY 1989, the development of preliminary capabilities required for the software quality and productivity laboratory will be initiated.

B. (U) Project: 2529, Computer Architecture Applications. This project evaluates commercial and Department of Defense developed computer architectures to determine their applicability and efficiency to Air Force $C^3I$ applications. Current emphasis is in developing an optical processor. Its inherent speed, hardness, and low power consumption make it ideal for many future systems. In FY 1987, development of a general purpose digital electro-optical computer started. Design specifications for the central processing unit (CPU), memory, and interconnections of an optical computer were also initiated with projected completion in FY 1988. In FY 1988, an effort to build and demonstrate the CPU will be initiated. Additionally, in FY 1988, three new study efforts will be conducted to: (1) evaluate the feasibility of using an optical medium to interconnect multiprocessors; (2) characterize optical switching devices; and (3) design an optical memory device. Promising technologies in areas of architecture, algorithm, device and material will be applied to and integrated into the evolving design(s) of a general purpose digital electro-optical computer. In FY 1989, evaluation of parallel processing architectures will be initiated.

C. (U) Project: 2530, Distributed System Reliability and Survivability. This project will provide the data processing backbone that will support interoperability among dispersed command centers (fixed, airborne, and mobile) and allow commanders immediate access to data at any location within the system. The primary goal is to develop a processing environment that provides survivability through reconfiguration in the event of lost components or nodes. The capability to combine physical dispersion and mobility while still maintaining single command authority is critical to strategic, tactical, and space command and control. It will support direct interaction of planning, execution, control and support elements through a common processing base. Continuation efforts in FY 1987 enchanced the Distributed Operating System (DOS) by the addition of upgraded resource control mechanisms which have improved performance and survivability. Also in FY 1987, efforts on the real-time distributed DOS continued. In FY 1988, a real-time distributed DOS prototype will be completed. In FY 1989, the real-time DOS prototype will be demonstrated. Commencing in FY 1989, issues involving multilevel security and the development of artificial intelligence to dynamically restructure the network after the loss of a base/node will be addressed.

D. (U) Project: 2532, Knowledge-Based Systems. This project focuses on the development of computer-based systems, called knowledge-based systems (KBS), able to solve reasoning problems which would otherwise require a

human expert. Performing as a surrogate for a human expert, a KBS is comprised of the following components: a rule set containing reasoning expertise, an inference process which uses the rules to solve problems posed by users, and an interface for communicating with users. This project has two major thrusts. The first is to provide software tools and techniques that can be used to develop and evaluate knowledge-based systems. The second thrust is the application of technology to provide cost-effective capabilities to develop and acquire knowledge-based systems for application such as weapon system maintenance, logistic planning, tactical and strategic decision support systems, resource allocation, situation assessment and intelligence analyses, and to exploit knowledge-based methods to effect an order of magnitude improvement in software development and support activities. In FY 1987, advanced development of the Knowledge-Based Software Assistant (KBSA) program was initiated. The KBSA will apply existing Artificial Intelligence (AI) technology to conventional software development activities to assist in improving programmer productivity and software reliability and maintainability. Also in FY 1987 efforts were initiated to develop a program to expand current AI technology to perform adaptive planning of Strategic Air Command operations for the strategic post-attack environments. In FY 1988, KBSA will be continued with emphasis in developing individual modules which address each phase of the software life cycle: system requirements, software requirements, preliminary and detailed design, code and debug, unit test and integration, formal testing, and operations and maintenance. In FY 1989, work will continue on the adaptive planning program and the KBSA facets. Commencing in FY 1990, work will be initiated to integrate the KBSA requirements and specifications facets into a single system sharing a common data base. Also in the outyears, a KBSA distributed knowledge-based architecture will be developed for supporting the entire life cycle.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603751F                                    Title: Training Systems Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD)    Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 1,823 | 276 | 470 | Continuing | N/A |
| 2557 | Advanced On-the-Job Training System | 1,812 | * | * | 0 | 10,613 |
| 3056 | Air Combat Assessment and Debriefing System | 11 | * | * | 5,000 | 5,011 |
| 3057 | Intelligent Computer-Assisted Training | 0 | 276 | 470 | 5,380 | 6,127 |

* In FY 1988, Projects 2557 and 3056 were combined into related Program Element 0603227F to meet Congressional direction to reduce the number of Program Elements. Due to administrative error, Project 3057 was not transferred. In FY 1990 and beyond, Project 3057 will be funded in Program Element 0603227F.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology Program funds development of cost-effective advanced technical training systems used to increase the efficiency and productivity of Air Force personnel. Rapidly changing technology and the increasing complexity of Air Force systems place increasing demands upon the training community for both formal school and on-the-job training. Intelligent computer-assisted training devices will help reduce training workload, and increase training effectiveness, without the need for increased manpower for training. These training devices will be especially amenable to high-flow career fields, high-technology environments, and the complex training requirements anticipated for space related technologies.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E (Project 3057 Only) | 0 | 276 | 471 | 5,380 | 6,127 |

EXPLANATION: (U) This is not a new start program element. Except for Project 3057, all projects formerly described under Program Element 0603751F are now documented in Program Element 0603227F, Personnel, Training, and Simulation Technology. Project 3057 will be consolidated in Program Element 0603227F beginning in FY 1990.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Related Air Force program elements are 0601102F, Defense Research Sciences; 0602205F, Personnel, Training and Simulation; 0603227F, Personnel, Training, and Simulation Technology; and 0603106F, Logistics Systems Technology. Related Navy and Army program elements are 0602757N, Human Factors and Simulation Technology; 0603701N, Human Factors Engineering Development; 0603720N, Education and Training; 0603743A, Education and Training. The Air Force Human Resources Laboratory closely monitors all significant research and development being conducted by other DoD, NASA, and industrial organizations. Exchange of proposed statements of work for contractual efforts, wide dissemination of technical reports, and attendance at symposia and meetings ensure that work conducted within this program element benefits from and does not duplicate work conducted bythe other Service laboratories. Close coordination within the Air Force user community is also accomplished by annual research and development coordination meetings between the Laboratories, the Aeronautical Systems Division, and the Major Commands.

6. (U) WORK PERFORMED BY: The program is managed by the Air Force Human Resources Laboratory, Brooks AFB, TX, through the Training Systems Division (AFHRL/ID), Brooks AFB, TX. Major contractors are: University of Southern California, Behavioral Sciences Laboratory, Los Angeles, CA (Project 3057).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3057, Intelligent Computer-Assisted Training (ICAT).

A. (U) Project Description: New and increasingly complex weapon systems and rapidly changing technology are vastly increasing Air Force training requirements while training resources remain relatively fixed. This requires the Air Force to rely more heavily upon on-the-job training and more efficient methods of training, such as computer-based training. This is especially true in areas that require high levels of training, such as space shuttle launch and control, space vehicle tracking, and space operations. This FY 1988 new start project will develop systems specifications for Intelligent Computer-Assisted Training (ICAT) in various training applications where payoff promises to be high, and identify technology demonstrations for these applications. ICAT differs from current conventional computer-assisted instruction in that this "intelligent" system makes judgments about what the student knows and how well he/she is progressing, tests those judgments, and provides appropriate instruction or assistance automatically, without the need for human instructor intervention. In effect, the training system acts as a tutor, not just a training delivery device. When completed, this project will provide field demonstrations of intelligent computer-assisted training applications and guidelines for expanded use.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable.

(2) (U) FY 1988 Program : This program is designed to capitalize on the advances in intelligent computer-aided instruction and personal computer engineering. It will focus on cost effective, efficient delivery of training. Phase I, in FY 1988, will consist of a comprehensive review and evaluation of state-of-the-art intelligent computer-assisted training technology and the computer hardware required for training development and delivery.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Phase II, beginning in FY 1989, will consist of initial software design and development of specifications for the prototype testbed. The design will include development of interactive design tools for course developers, and modeling to allow for adaptation of training delivery for multiple instructional environments, differences in student ability, and differences in instructional presentation, and automated expertise capturing systems.

(4) (U) Program to Completion: In FY 1990, full scale development of the intelligent computer-assisted training (ICAT) testbed will begin, with demonstrations and evaluations beginning in FY 1991. The ICAT testbed will be demonstrated on selected high technology space-related specialties in cooperation with the Air Force Undergraduate Space Training school at Lowry AFB, Colorado. Evaluations will include assessments of training and cost effectiveness for various ICAT applications and guidelines for expanded use. Outyear efforts will also include downloading from specialized artificial intelligence processing machines to standard Air Force computer systems.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Complete Software/Hardware Design | September 1989 |
| (2) (U) Complete Development of Testbed | September 1990 |
| (3) (U) Begin Field Demonstration and Evaluations | September 1990 |
| (4) (U) Final Report and Recommendations | September 1992 |

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603789F
DOD Mission Area: 551 - Electronic & Physical Science (ATD)

Title: Tactical Command, Control & Communications ($C^3$) Advanced Development
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | *FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 13,448 | 30,000 | 18,795 | Continuing | N/A |
| 2314 | Tactical Air Surveillance | 9,256 | 6,471 | 1,444 | Continuing | N/A |
| 2317 | Tactical Information Distribution | 815 | 1,725 | 1,945 | Continuing | N/A |
| 2321 | Tactical Battle Information Management | 1,985 | 3,817 | 2,046 | Continuing | N/A |
| 2333** | Tactical Radar Electronic Counter-Countermeasures (ECCM) | 0 | 2,830 | 3,346 | Continuing | N/A |
| 2335** | Communication & Navigation Electronic Counter-Countermeasures | 0 | 4,207 | 3,436 | Continuing | N/A |
| 2478**** | Tactical $C^3$ Architecture | 96 | 0 | 0 | Continuing | N/A |
| 2747*** | Communication Vulnerability Analysis | 0 | 514 | 328 | Continuing | N/A |
| 2748*** | Advanced High Frequency Technology | 0 | 200 | 250 | Continuing | N/A |
| 2749*** | Hardened Antenna Technology | 0 | 50 | 0 | N/A | 3,261 |
| 3192**** | Tactical Optical Disk | 1,296 | 0 | 0 | Continuing | N/A |
| 3433**** | Advanced Communication Technology | 0 | 10,186 | 6,000 | Continuing | N/A |

** Transferred from PE 0603750F
*** Transferred from PE 0603727F
**** Transferred from PE 0603431F
**** Transferrred to PE 0603726F

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Modern tactical battle scenarios are complex and dynamic. Extreme pressure will be on surveillence, command and control, and communications elements to maximize combat effectiveness. These combat tools must survive and operate together for the battle commander to effectively control

his forces. New technologies for these tools must also grow together and be directed towards an integrated tactical control system which will overcome the threat and support current force doctrine. Accordingly, this science and technology program develops and demonstrates surveillance, command, control, and communications technology to support air superiority, close air support missions, and satellite to satellite communication relay in tactical operations. Specific vulnerabilities and counter-countermeasures are evaluated and developed. Includes conceptual system design, system engineering and fabrication of advanced development models for test and demonstration.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 18,647 | 42,809 | 47,696 | Continuing | N/A |

EXPLANATION: (U) FY 1987 and FY 1988 differences due to Congressional reduction. FY 1989 changes due to Air Force TOA reductions.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is a key part of the Air Force effort to improve surveillance, command, control, and communications capabilities. Related technology development programs are 0602702F, Command, Control, and Communications; 0603742F, Combat Identification Technology; 0603726F, Fiber-Optic Development; 0603260F, Intelligence Development; 0603203F, Advanced Avionics for Aerospace Vehicles; 0604710F, Reconnaissance Equipment; and 0604748A, Army Modular Integrated Communication/Navigation System. Technologies developed by this program are being coordinated with and will directly feed 0207411F, Overseas Air Weapons Control Systems; 0207412F, Tactical Air Control System; 0207423F, Advanced Communication Systems; 0207417F, Airborne Warning and Control System; 0603401F, Advanced Spacecraft Technology; 0602702F, $C^3$; and 0305110F, Satellite Control Facilty.

6. (U) WORK PERFORMED BY: This program is managed by Air Force Systems Command, Andrews AFB MD, with project efforts being conducted by the Electronic Systems Division, Hanscom AFB, MA, and Rome Air Development Center, Griffiss AFB, NY, and Air Force Space Technology Center, west cost office, Los Angeles, AFB, CA. Current contracts are for solid state transmit/receive module design, Advanced Tactical Surveillance Radar cost performance trade-off studies, an advanced tactical radar transmitter, reassessment of antenna sidelobe performance requirements, demonstration of automatic adaptive radar control, low cost phase shifters, bistatic Identification Friend or Foe, modification of Tactical Analog/Digital Information Link - A for the Advanced Tracking System, and a Tactical Expert Mission Planner. Magnavox Data Systems, Falls Church, VA is the main contractor for communications vulnerability analysis (2747). ITT Avionics Division, Nutley, NJ is working the high frequency technology efforts (2748). The Advanced Airborne Surveillance Radar (AASR) efforts have been conducted by the Boeing Corp., Seattle, WA; Westinghouse, Baltimore, MD; and Grumman

Aerospace, Bethpage, NY (2333). Decoy studies for current and follow-on tactical radars have been performed by GRC, Santa Barbara, CA and General Electric, Utica, NY (2333). The Advanced Mainbeam Electronic Counter-Countermeasures (ECCM) Technology Radar (AMETR) is being developed by International Telephone and Telegraph Gilfillan, Van Nuys, CA (2333). The Low Cost 20 Megahertz Data Link is being developed by Hughes Aircraft, Los Angeles, CA (2335) . MITRE Incorporated, Bedford, MA, provides support for Projects 2314, 2321, 2747 and 2748. Perkin-Elmer, Danbury, CT, under contract to Lincoln Laboratory, Bedford, MA, are conducting development efforts in Project 3433.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2314, Tactical Air Surveillance: This program develops advanced radar technology supporting the Advanced Tactical Surveillance System (ATSS). The goal of the ATSS is to provide continuous and reliable air surveillance and current depiction of the friendly and hostile airspace situation. It includes (1) detection of air activity; (2) continuous tracking of all detected objects; (3) passive detection of Electronic Countermeasures and Identification Friend or Foe emitters; (4) identification and classification of targets (cooperative and non-cooperative); and (5) sensor track correlation. This project evaluates advanced technology such as Solid State Transmit/Receive (T/R) module conceptual design and system engineering and demonstrates equipment and/or procedures that address users' stated requirements for an ATSS. These efforts are required to develop affordable radar technologies supporting the FY93 planned start of the ATSS Advanced Tactical Surveillance Radar program. The FY 1987 program involved continuation of seven high technology areas previously initiated for the Advanced Tactical Surveillance Radar (ATSR): (1) detailed radar system trade-off studies, (2) development and test of solid state transmit/ receive modules, (3) development of a technology base to reduce cost and increase efficiency of phase shifters for phased array radars, (4) reassessment of antenna sidelobe performance requirements via simulation/field tests, (5) reassessment of tracking computation requirements (6) development and test of a highly stable brassboard transmitter with variable duty cycle, and (7) demonstration of automatic adaptive radar control. The detailed system trade-off studies were expanded to incorporate the very low cross section target threat. Two investigation and design concepts were started for dual frequency radar to counter this threat. In FY 88, work will continue on remaining high technology areas with the following efforts being completed: (1) detailed radar system trade-off studies including the very low cross section threat, (2) development of solid state transmit/receive modules, (3) development of low cost phase shifters, (4) development and test of a highly stable brassboard transmitter, and (5) demonstration of automatic adaptive radar control in noise/clutter/electronic countermeasures environments. The dual frequency radar investigations will be completed. In FY 1989 the project will develop technology to counter the very low cross section target threat. Clutter data collection and analysis will be started to provide a data base for evaluation of system parameters and performance. The defined radar parameters developed in cost/performance and dual frequency trades will be transitioned to technology development in antenna, transmitter, and signal processor. Those performance parameters defined as high technical risks and requiring development will be pursued. Specific areas to be addressed will be phase and amplitude control, beamforming techniques, and RF power generation, techniques for deployment of very low frequency antennas, and mobility requirements.

B. (U) Project: 2317, Tactical Information Distribution. This project transitions Advanced Communications Technology to Tactical Command and Control Systems (TACS). These technologies are required to accommodate the extensive

communications requirements of future TACS. In FY 1988, the automated decentralized information exchange definition phase will transition to a three year demonstration program. Sensor netting developments will be undertaken in support of the Advanced Tactical Surveillance System development. Developments will commence for the netting of voice and databases among command and control centers by netting current and planned radars into a single, multilevel-secure, multimedia communications resource. In FY 1989, a four year program will commence to demonstrate a secure, multimedia, anti-jam, programmable modem/controller.

C. (U) Project: 2321, Tactical Battle Information Management. This project will improve decision making tools and Artificial Intelligence (AI) techniques to support command and control operations in high stress and time critical environments. It allows improved operations with inexperienced operators through AI based decision aids. This technology-based effort is directed at deficiencies spelled out in the Tactical Air Force Integrated Information System Master Plan. The Tactical Expert Mission Planner (TEMPLAR) applies AI techniques to the Tactical Air Force resource allocation process using automated data processing based decision aids to facilitate generation of an Air Tasking Order (ATO). The follow-on Advanced Planning System (APS) program will incorporate proven technology (demonstrated in TEMPLAR and other decision aid programs) into a deployable, supportable contingency TACS Automated Planning System baseline. This will provide HQ TAC with an advanced ATO generation capability in conjunction with with the Tactical Air Control Center (TACC) modernization program. The Advanced TACC program will attempt to demonstrate an order of magnitude manpower reduction through the application of a family of cooperating decision aids. This project also seeks to improve today's Tactical Air Control System (TACS) in an evolutionary manner, building toward a survivable 21st Century TACS through the integration and application of technology developments in distributed database management, distributed processing, decision aids, and survivable communications networks. This project will demonstrate a more survivable, flexible command and control system consistent with the goals of the 21st Century TACS study. Demonstrations of this system will be accomplished using the Rome Air Development Center (RADC) Command and Control Technology Lab and Mobile Laboratory.

D. Project: 2333, Tactical Radar Electronic Counter-Countermeasures (ECCM). This project develops ECCM technology applicable to search and surveillance radars such as TPS-43, APY-1/APY-2 (E-3 AWACS), and generic future radars.

Tasks include demonstration of: advanced radar mainbeam technology to counter noise jamming and interference through adaptive nulling; the Advanced Airborne Surveillance Radar (AASR) as an advanced ECCM follow-on to AWACS; and anti-radiation missile (ARM) decoy technologies to negate enemy destructive countermeasures. FY 1987: Completed Advanced Mainbeam ECCM Technology Radar (AMETR) nulling experiment and software development. Developed the Advanced Tactical Surveillence Radar (ATSR) ARM decoy advanced development model specification. Began development of a 1000 CAM array for flight demonstration of AASR conformal array technology. FY 1988: Complete preliminary and critical design reviews for the AASR conformal array. Validate results of the AMETR nulling experiments. Complete preliminary and critical design reviews for the ATSR ARM decoy. FY 1989: Continue AMETR effort. Continue AASR technology ground demonstration. Begin procurement of AASR components for flight demonstration. Begin smart jammer study. Continue validation of (AMETR) nulling experiments.

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systems to satellite systems. Both Military Airfift Command (MAC) and Strategic Air Command (SAC) have stated requirements for this improved capability (SAC Required Operational Capability 5-77, MAC General Operational Requirement 3-77).

Advanced capability Electronic Counter-Countermeasures modules will be developed that may be applied to future HF radio enhancements. In FY 1987 this project continued work on the narrowband High Frquency (HF) Electronic Counter-Counter Measures (ECCM) modem, to be used with the HF standard airborne radio (AN/ARC-190). In FY 1988, this modem will be tested in use with the AN/ARC-190 and its Automatic Communications Processor. These tests continue through FY 1989.

H. (U) Project: 3433, Advanced Communication Technology. This project will develop optical (heterodyne laser) space communications techniques that offer survivable, high data rate crosslinks for future satellites. In FY 1987, the laser communication inter satellite transmission experiment (LITE) completed both the priliminary and critical design reveiws. In FY 1988, due to congressional funding cuts, cost growth of the experiment, and slips in NASA launch capabilities, the LITE was no longer executable. Instead, the project was revised to concentrate on to demonstrating the critical laser crosslink capability within existing funding constraints. Engineering models will be developed to demonstrate the heterodyne laser spatial/acquisition tracking system to reduce cost and technical risk for application as a ultra high data rate communications system for intelligence relay and multiple user internetting. In FY 1989, the engineering models will be delivered, tested, and evaluated at Lincoln Laboratory.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

NOTE: This PE is undergoing revision, and updates will be provided as they are realized.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603265F
DOD Mission Area: 113 - Airborne Strike

Title: Conventional Long-Range Cruise Missile
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimate Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 0 | 0 | 50,000 | TBD | TBD |
| 3767 | Cruise Missile Advanced Propulsion Demonstration | 0 | 0 | 8,500 | TBD | TBD |
| 3768 | Conventional Long-Range Cruise Missile Guidance Demonstration Program | 0 | 0 | 41,500 | TBD | TBD |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This advanced development effort demonstrates in a system environment critical technologies required to field a Conventional Long-Range Cruise Missile to support nonnuclear missions of the Air Force and the Navy. The program includes 1) flight demonstration of advanced laser radar (LADAR) seeker technology to achieve near-zero Circular Error Probable (CEP); 2) target identification, classification, and aimpoint selection; 3) autonomous midcourse navigation; 4) terrain following and obstacle avoidance; 5) advanced propulsion techniques; and 6) simplified mission planning. This program will also establish methodologies and techniques for modeling and evaluating conventional cruise missile performance to include simulation, laboratory subsystem testing, and full-scale flight testing. Planning will be conducted for possible follow-on development activity.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: Not Applicable. New program.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Balanced Technology Initiative (BTI) (PE63737D) | 3,[illegible] | 4,000 | 3,000 | 0 | 10,000 |

5. (U) RELATED ACTIVITIES: Related activities are ongoing in the areas of advanced guidance and propulsion systems. The advanced guidance development effort will build on two currently ongoing Air Force LADAR technology development programs. The first is the Cruise Missile Advanced Guidance (CMAG) program funded by PE 0603203F, Advanced Avionics for Aerospace Vehicles, and the second is the Tactical LADAR Seeker (TLS) program funded by PE 0603601F, Conventional Munitions. The CMAG program is managed by Air Force Wright Aeronautical Laboratories to conduct captive flight subsystem demonstrations of LADAR hardware and software design in the areas of midcourse guidance through position

and velocity updating of inertial navigation systems, avoidance of flight path path obstacles, bomb damage assessment, target acquisition/aimpoint selection, and near-zero Circular Error Probable (CEP). The TLS program is managed by the Air Force Armament Laboratory to conduct captive flight subsystem demonstration of LADAR hardware and software designs also in the area of target acquisition/aimpoint selection. The TLS development is currently emphasizing performance against stationary and moveable targets. In the area of propulsion development, Aeronautical Systems Division is completing a concept study for a free-flight propfan engine demonstration. This work has been done under the Engine Model Derivative Program (EMDP), PE 0604218F. The above related programs will be coordinated with the Conventional Long-Range Cruise Missile Program.

6. (U) WORK PERFORMED BY: This program is managed by the Conventional Cruise Missile System Program Office under the Deputy for Air-to-Surface Guided Weapons, Armament Division, Eglin AFB FL.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3767, Cruise Missile Advanced Propulsion Demonstration: This project will design, develop, and demonstrate an advanced technology propulsion system for conventional long-range cruise missile applications. The primary objectives are to increase thrust and reduce fuel consumption over current technology options. The advanced propulsion capability will enhance overall range/payload effectiveness. Weapon survivability will be substantially improved through increased thrust which will allow lower terrain following altitudes, and through reduced signature. This program will continue work toward a 1991 flight demonstration that was initiated under EMDP. It is estimated that flight hardware could be available for ground testing as early as late 1990 with flight testing beginning in mid-1991.

(U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3768, Conventional Long-Range Cruise Missile Guidance Demonstration Program.

A. (U) Project Description: This joint AF/Navy program will demonstrate key system and subsystem technical issues regarding the application of LADAR technology to conventional long-range cruise missiles. The purpose of the program will be to conduct a captive and free-flight demonstration of a LADAR guidance system in an existing airframe, and to address cruise missile air vehicle performance definition of payload requirements, continued demonstration of LADAR signal processing, concepts for more responsive mission planning, and propulsion integration. It is planned to award at least two contracts to conduct free-flight testing which will demonstrate the unique capability and flexibility of the LADAR system. The following critical issues are planned for demonstration: autonomous midcourse guidance using navigation updates from the LADAR seeker, target detection/classification/aimpoint selection, terrain following, terrain avoidance obstacle avoidance, near-zero miss distance and simplified mission planning. In addition, studies will be performed to address weaponization issues needed to reduce the risk of a follow-on development program. Eventually, steps will be taken to combine the propulsion upgrade with LADAR into an integrated flight demonstration effort.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable

(2) (U) FY 1988 Program: Not Applicable

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A system demonstration of LADAR guidance and advanced propulsion capabilities will be performed to validate the maturity of these critical technologies for application to conventional long-range cruise missiles. This will provide the basis for an effective capability against targets which cannot be held at risk by current conventional weapon systems. The demonstration of the LADAR guidance system will show the advantages of flexible target acquisition and classification to overall weapon utility. Demonstration of aimpoint selection capability and very accurate terminal performance will show marked improvements in weapon effectiveness. Integration of advanced propulsion technology will demonstrate enhanced aero/propulsion capabilities necessary to meet range and terrain following requirements. Analysis will be performed to determine the desirability and feasibility of recovering free flight test vehicles during the portion of the flight test program dealing with autonomous navigation systems, obstacle avoidance, terrain following, and target detection/classification. As a joint service program with the Navy, the demonstration of the critical technologies will provide both services the advances needed to support follow-on programs which meet specific mission requirements.

(4) (U) Program to Completion: TBD

C. (U) Major Milestones: TBD

9. (U) COOPERATIVE AGREEMENTS: TBD

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603311F
DOD Mission Area: 111 - Land-Based Strike
Title: Advanced Strategic Missile Systems (ASMS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 149,997 | 133,640 | 151,836 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Air Force program develops, applies, and proves ballistic missile technology by conducting advanced development for operational intercontinental ballistic missile (ICBM) system applications. Early development work is pursued to gain confidence in engineering feasibility of new technologies and concepts to insure their readiness for full-scale development and to provide timely solutions for identified ICBM mission changes and evolving threats. ASMS also conducts tri-Service intercontinental range flight testing of exploratory reentry vehicles and penetration aid systems. The combination of Soviet throwweight advantages, capability to field advanced anti-ballistic missile defenses, continuing efforts to upgrade offensive effectiveness (e.g. better missile accuracy), and increased pace in projecting force, all point to a need for the United States to be prepared to upgrade the missile force with offsetting advanced weapons systems.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 145,000 | 134,162 | 151,979 | Continuing | N/A |

EXPLANATION: (U)

(U) RDT&E: Increase in RDTE funding in FY 87 relects the correction of an error in the FY 88/89 Descriptive Summary.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: ASMS efforts are coordinated with the activities of the Army's Strategic Defense Command; the Navy's Strategic Systems Program Office; the Defense Advanced Research Projects Agency; the Defense Nuclear Agency; the Department of Energy, Military Applications; the Strategic Defense Initiative Office; Government laboratories and testing facilities; and other agencies associated with ballistic missiles, reentry and penetration technologies, and assessments of basing modes for high survivability and endurance. Efforts are coordinated with the Minuteman program (PE 0101213F) and the ICBM Modernization (Peacekeeper, Peacekeeper Rail Garrison, Small ICBM) program (PE 0604312F) for development of advanced re-entry vehicles, penetration aids systems, advanced missile

(U) guidance, and demonstration launches. Tri-Service and intra-Air Force coordination is achieved through annual program reviews and working level exchanges. Effective coordination and avoidance of duplication with the ICBM Modernization and Minuteman programs are achieved through joint management and collocated program offices within the Ballistic Missile Office.

6. (U) WORK PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton Air Force Base, CA. Major contractors include: McDonnell Douglas Astronautics, Huntington Beach, CA (maneuvering reentry vehicle technology, defense suppression vehicle); TRACOR Aerospace, Austin, TX (penetration aids, deployment system); Textron Inc, Wilmington, MA (advanced nosetip testing, defense suppression vehicle, optical penetration aids); Acurex Corporation, Mountain View, CA (radar and optical penetration aids), and the Boeing Company, Seattle, WA (launch services). The ASMS program currently maintains contracts with 45 contractors and makes extensive use of Government laboratories. Total definitized value of current contracts is $326.4 million, with some periods of performance extending through calendar year 1990.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0603311F, Advanced Strategic Missile Systems

A. (U) Project Description: This program is a continuing activity that conducts advanced development of key ballistic missile, reentry, and basing systems/subsystems to correct deficiencies and maintain effectiveness of our ICBM force. This development process accomplishes system definition and requirements analyses, preprototype fabrication and both ground and flight testing, all paced to achieve baselined milestones identified and coordinated by the using command (Strategic Air Command) and the implementing command (Air Force Systems Command). The program directly address six Strategic Air Command Statements of Operational Need.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The Peacekeeper penetration aids deployment systems (PADS) was flown with both active and passive decoys in FY 1987. Two Minuteman III flights were flown in support of the Small ICBM alternative guidance system and two Severe Environment Nosetip Tests (SENT) were flown on separate Minuteman I flights. Miniaturization and hardening of the active decoy was initiated. In the maneuvering reentry vehicle technology program, efforts to develop radiation hardened parts and an advanced inertial measurement unit (IMU) began. Terminal fix sensor (TFS) candidates completed their first series of aircraft-captive flight tests. Efforts to develop a preliminary design for an earth penetrator vehicle capable of attacking hard, deeply buried, time-urgent targets also began in FY 1987. Ground testing of selected optical countermeasure concepts was initiated.

(2) (U) FY 1988 Program: FY 1988 funds continue advanced development and ground testing of the active decoy. The maneuvering reentry vehicle (MaRV) technology demonstration program continues with the Antenna Test

Vehicle (ATV) flight on a Minuteman I and the completion of the aircraft-captive flight tests for the terminal fix sensor (TFS). Radiation hardened parts and advanced IMU development tasks also continue. Various nosetip and antenna window materials will be flight tested in the Maneuvering Systems Technology (MAST) program, using a Minuteman I booster. Peacekeeper PADS with decoys will be flown on a Peacekeeper flight test. In addition, seven sounding rocket flights will be flown in support of the United Kingdom, the Strategic Defense Initiative Organization, the Minuteman III penetration aids program, and ASMS. For the optical countermeasures program, ground testing in both the Evader Replica Penetration Aid (ERPA) program and the pyrotechnics program will continue, as will optical data collection. Advanced guidance concepts will be explored. The earth penetrator weapon preliminary design effort continues.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 funds will be used to continue advanced development and ground testing of the active decoy. In the optical countermeasures program, groundtesting will continue and in the Evader Replica Penetration Aids (ERPA) program, the flight test phase will be initiated. Detailed design of flight test and operational vehicles will be started. Optical data collection activities will continue. Efforts to define concepts for attacking strategic relocatable targets will continue, as well as a preliminary effort to build and test potential candidates for attacking hard, deeply buried, time-urgent targets. ASMS will provide flight test support for five Minuteman flights and 3 sounding rocket flights for Strategic Defense Command target tests. Costs for ASMS advanced development tasks were estimated as of November 1987, based on negotiated contractor prices and Government experience on similar advanced development programs. Ongoing ASMS program costs are category III, Budgetary, and planned efforts are category IV, Planning.

(4) (U) Program to Completion: Follow-on Minuteman I flight tests will be conducted in the outyears for upgrades to the Peacekeeper and Minuteman III penetration system options (e.g., advanced radar/optical penetration aids and decoys, maneuvering vehicles) to meet the evolving Soviet defensive threats. Efforts will continue on selected concepts that could provide Intercontinental Ballistic Missiles with the capability to attack relocatable targets and buried targets.

C. (U) Major Milestones: Not applicable since decisions have not been made to pursue engineering development, production, or deployment of these systems. Advanced development milestones are described above.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603364F
DOD Mission Area: 113 - Airborne Strike

Title: Short Range Attack Missile II (SRAM II)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 65,547 | 174,320 | 231,467 | 529,300 | 1,065,403 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Strategic Air Command requires an improved Short Range Attack Missile (SRAM) to improve the operational flexibility of our penetrating bombers by providing a single weapon to strike defended, hard and relocatable targets without having to directly overfly targets. SRAM II is a supersonic, air-to-ground nuclear weapon that severely stresses the defensive threat. The combination of supersonic speed, low observability and variable flight profile makes SRAM II highly survivable in terminal defense zones. SRAM II significantly compounds enemy defense requirements and prevents optimization of defenses against low altitude subsonic targets. The required performance improvements relative to SRAM-A are attainable with existing technology. It is not the intent of this program to stress technology to its limits, but rather to build a state-of-the-art SRAM II using available technology.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 66,528 | 220,386 | 231,589 | 516,018 | 1,064,203 |
| Missile Procurement | 0 | 0 | 0 | 1,414,800 | 1,414,800 |

EXPLANATION: (U) RDT&E: The small reductions in FY 1987 reflect reprogramming for other higher priority projects. The FY 1988 reduction reflects Congressional appropriation.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Funds | 0 | 0 | 0 | 1,310,500 | 1,310,500 |
| Quantities | 0 | 0 | 0 | 1633 | 1633 |

5. (U) RELATED ACTIVITIES: SRAM II will be developed for internal carriage on the B-1B (PE 0604226F) and B-2 (0604240F). Activity will be conducted to integrate SRAM II on the multipurpose launcher. Funds are programmed in the B-1B program element to procure the hardware modifications to support SRAM II carriage. The SRAM II program element contains the RDT&E funds to develop the B-1B hardware modifications.

6. (U) WORK PERFORMED BY: Boeing Aerospace Company, Seattle, WA, and McDonnell Douglas Astronautics, St Louis, MO, responded to our request for proposals. Boeing Aerospace was announced as the winner of the competition. Boeing Military Airplane Co, Wichita, KS, Boeing Military Airplane Co, Seattle, WA, and Rockwell International, El Segundo, CA, will integrate SRAM II on the B-1B aircraft. The SRAM II program will be directed by Air Force Systems Command's Aeronautical Systems Division, Strategic System Program Office, Wright-Patterson AFB, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: PE 0603364F, Short Range Attack Missile II

A. (U) Project Description: The current SRAM is showing signs that it may be rapidly approaching the limits of its service life. Furthermore, the remaining SRAM inventory is steadily declining and is inadequate to support our penetrating bomber force structure It is prudent that we begin to actively develop a replacement for SRAM. SRAM II will address the concerns we have with SRAM including the need for performance improvements that will insure that our future bombers are weaponized with a high performance air-to-surface weapon that can defeat projected terminal defenses. An operational concept based on years of experience with SRAM is incorporated into the acquisition strategy which uses existing technologies in order to minimize risk and shorten the acquisition cycle.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: A contract was signed for full scale development. Both the missile system contractor and B-1B aircraft integration contractor began design and development of critical components. For the missile contractor, these components are airframe, rocket motor and tail assembly. The missile contractor began piece part design of the inertial guidance system, the missile computer and flight control software. The contractor also started missile integration work with the carrier aircraft contractor. The B-1B aircraft integration contractor began hardware and software development for modifications to the rotary launcher and the launcher avionics equipment Both contractors have started planning activities for the ground and flight test programs.

(2) (U) FY 1988 Program: This will be the first year dedicated to missile full scale development (FSD) activities. Preliminary design reviews for the missile, rocket motor, avionics software and training equipment will all be conducted. Once the missile and aircraft interfaces have been defined, full scale integration testing will begin. Component testing and analysis of all missile systems and subsystems will continue. Prototype rocket moter firings will continue to refine the selected design.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full scale development (FSD) activities will continue, leading to design completion for the missile air vehicle, its components and aircraft interface. These efforts will include completion of air vehicle cross section testing, warhead impact fuse sled testing, ground navigation guidance accuracy and reliability testing, fin actuator testing and rocket motor preliminary flight rating testing. Fabrication of the flight test missiles will begin. Plans for flight testing will be finalized. Cost data is based upon a full scale development contract with the missile contractor, Boeing Aerospace Company, the aircraft avionics contractor, Boeing Military Aircraft Company, and the aircraft integrator, Rockwell International. Cost estimate category is III.

(4) (U) Program to Completion: After FY 1989, considerable ground testing and evaluation will continue prior to the first live launch in the fourth quarter of FY 1990. A total of 25 planned live launches and approximately an equal number of captive carry/simulated launches will be conducted. Flight testing will be completed in FY 1992. Low rate initial production approval is planned for FY 1991 with full rate production approval planned for FY 1992.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Defense Resources Board approval new start | | July 1983 |
| (2) (U) System Definition Study contract award | | February 1985 |
| (3) (U) Begin Full Scale Development | | 2nd Quarter FY 1987 |
| (4) (U) Defense Acquisition Board (DAB) Milestone II Review | *(3rd Quarter FY 1987) | 4th Quarter FY 1987 |
| (5) (U) First flight | *(1st Quarter FY 1990) | 1st Quarter FY 1991 |
| (6) (U) Low rate initial production (LRIP) | *(3rd Quarter FY 1990) | 3rd Quarter FY 1991 |
| (7) (U) Full rate production (FRP) | *(4th Quarter FY 1991) | 4th Quarter FY 1992 |
| (8) (U) Initial Operational Capability (IOC) | *(2nd Quarter FY 1993) | 3rd Quarter FY 1993 |

*Date presented in FY 1988/FY 1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(4) (U) DAB Milestone II Review delayed one month
(5) (6) (7) (U) Delayed first flight reflects currently proposed schedule by B-1B integration contractors
(8) (U) IOC delayed one month

9. (U) Cooperative Agreements: Not Applicable

Budget Activity: 3. Strategic Programs
Program Element: 0603364F, Short Range Attack Missile (SRAM II)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603367F
DOD Mission Area: #113 - Airborne Strike

Title: Relocatable Target (RT) Capability
Budget Activity: #3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 4,494 | 9,961 | 19,705 | Continuing | N/A |
| 3368 | RT Capability | 4,494 | 9,961 | 19,705 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: For more than a decade the Soviets have fielded mobile intermediate range ballistic missiles (IRBMs) such as the SS-20. They have recently begun to deploy mobile intercontintental ballistic missiles (ICBMs) which include the SS-24 rail mobile and SS-25 road mobile systems. Responding to this new threat, This requirement includes the capability to find and target those Strategic Air Command (SAC) presently This program develops, tests, and evaluates The DARPA RT Detection program, which is being conducted in close coordination with the Air Force program, is focusing on advanced sensors and the fundamentals of the detection of RTs is a high clutter background. Both of these programs are necessary to reduce the technology risk and to develop the sensors, $C^3I$ and force structure to on an urgent basis.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 4,494 | 16,495 | 23,723 | Continuing | N/A |

EXPLANATION: (U)

- (U) FY 1988: Congressional reduction of $6.5 million in FY 1988 based on the potential of RT research program benefiting from related intelligence programs that are on-going. Impact of reduction slips sensor automatic target cueing development one year.

- (U) FY 1989: OSD directed reduction of $4.0 million in FY 1989 slips advanced mission planning research one year.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: PE 0604326F, Strategic Conventional Standoff Capability (SCSC), project 3076, High Resolution Radar (HRR) demonstration, supports development of an HRR with applicability to the RT mission. An SCSC/RT Target Signature Analysis effort ongoing within this PE was transferred to PE 0603367F in FY 1987. PE 0603227E, DARPA RT Detection program, supports Air Force program and focuses on advanced sensors and fundamental of target detection in high clutter backgrounds.

6. (U) WORK PERFORMED BY: Air Force Wright Aeronautical Laboratory (AFWAL) has management responsibility for the overall program. This includes airborne sensor development, avionics architecture, processors, on-board adaptive mission planning, automatic target cueing and recognition. Armstrong Aerospace Medical Research Labratory (AAMRL) is an associate product division for human factors analysis and requirements. Rome Air Development Center (RADC) has developed an RT sensor demonstration and target signature analysis test plan and will be responsible for scheduling and conducting sensor tests and exploiting collected data. Specific flight tests/demonstrations will be conducted by RADC by contracting with individual candidate sensor development programs.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3368, Relocatable Target (RT) Capability.

A. Project Description: This project develops technology to hold RTs at risk in the future. Three initiatives are being pursued--aircraft sensor test and evaluation, automatic target cueing (ATC) applications and weapon system operator (WSO) performance evaluation. RDT&E efforts will identify sensors for the RT mission. Candidate solutions include

Effort will flight test and gather data to assess

ATC application development will examine the capability of developing expert knowledge systems capable of processing data to aid crewmembers in target identification. It will assess capability to process data onboard the aircraft to allow real-time target identification and strike. WSO performance evaluation will use the cueing process as defined by the ATC effort to prompt crewmembers and allow us to determine the actual system performance we would expect in an operational scenario.

B. (U) Program Accomplishments and Future Efforts:

Program Element: #0603367F  Title: Relocatable Target (RT) Capability
DOD Mission Area: #113 - Airborne Strike  Budget Activity: #3 - Strategic Programs

(1) FY 1987 Accomplishments: RT capability efforts assessed ongoing targeting sensor programs and their applicability to the RT problem. This included flight testing against and examining artificial intelligence technology for target assessment with acquired sensor data.

(2) FY 1988 Program: Flight test of ongoing targeting sensor candidates will continue. Auto target cueing (ATC) development will begin. Key candidate sensors will be test flown. Detailed experiments will begin to assess the technical feasibility of developing sensor systems to detect and identify stationary targets in a realistic nautural background. The will provide the detailed technical assessment essential to support decision making for future weapon systems integration. Weapons system operator (WSO) performance evaluations will begin with the training of a small group of subjects in a laboratory environment to determine target classification and recognition performance for human operators. FY 1988 activities will culminate in a RADC parametric analysis was done to estimate cost.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Analysis of concept/operation validation results and any necessary follow-up testing/adjustments will complete the initial RT sensor testing phase. Concept evaluation involves the planning and execution of technology and/or capability demonstrations. For the most part, these demonstrations will be laboratory simulations of the actual mission performance. A typical effort will involve actual data collection (or data previously collected), data characterization, ATC processing, WSO performance measurement, and then final performance evaluation. The next step will combine the ATC performance model and the WSO performance model to evaluate the overall target acquisition process. The end product will provide an estimate of the percentage of targets found versus the scene parameters. This analysis provides the framework we will then use to conduct sensor characterization and modeling efforts to identify promising sensor candidates for the RT mission. A candidate sensor suite will undergo an integration analysis phase to determine system design leading to a full-scale development of a prototype sensor suite. Utility study will begin for a highly calibrated sensor systems design.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestone:

| Milestone | Date |
|---|---|
| (1) Milestone 0 | 4 Qtr FY 1988 |

Remainder TBD upon finalization of candidate sensor test scheduled for FY 1988.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603717F
DOD Mission Area: 205 - Physical Security Systems

Title: Technical On-Site Inspection (TOSI)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 10,452 | 10,627 | 9,291 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program will design, fabricate and test an engineering model of a Technical On-Site Inspection (TOSI) system which can be incorporated into an arms control proposal to the Soviet Union. The TOSI system is a perimeter/portal monitoring system capable of

The program will complete and refine the baseline system concept and its sensor components. It will also design, develop, acquire, integrate, and test the system (including the construction and operation of a full scale test facility). This program responds to Deputy Secretary of Defense direction to develop technology necessary to construct a TOSI System. United States policy is that any arms control agreement should be verifiable. This program provides a system that, together with existing National Technical Means and additional cooperative measures, will enable the U.S. to detect and deter violations of missile inventory limits at facilities where the monitoring system is installed.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMA4Y: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 6,513 | 3,819 | 3,813 | Continuing | N/A |

EXPLANATION: Air Force reprogrammed $6.850 million (FY 1988) and increased the FY 1989 Request to $9.300 million to support acceleration of this program to keep pace with the accelerated schedule of the Intermediate Range Nuclear Forces Treaty discussions.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Funding for this activity was previously provided under PE 0603714F, DOD Physical Security Equipment-Exterior.

6. (U) WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, Electronics Systems Division, Hanscom AFB, MA. The work is performed by Sandia National Laboratory, Albuquerque, NM.



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Program Element: 0603717F
DOD Mission Area: 205 - Physical Security Systems

Title: Technical On-Site Inspection (TOSI)
Budget Activity: 3 - Strategic Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0603717F, Technical On-Site Inspection (TOSI)

A. Project Description: This project provides a system that, together with existing National Technical Means and additional cooperative measures, will enable the United States to detect and deter violations of treaty limited components at facilities where the monitoring system is installed. This project will design, fabricate and test an engineering model of a perimeter/portal monitoring system capable of [redacted] The program will complete and refine the baseline system concept and its sensor components. It will also design, develop, acquire, integrate and test the system (including the construction and operation of a full scale engineering model). When sufficiently complete, the TOSI system model could be used for demonstration to the Soviet Union during arms control negotiations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The TOSI became a separate effort in FY 1987. Development continued for the overall TOSI system. Candidate components were acquired and integrated into a system configuration. Test and evaluation at the system and subsystem level began December 1986. Efforts were initiated to define a Portal Monitoring system for deployment in the Soviet Union in CY 1988 supporting the Intermediate Range Nuclear Forces Treaty upon ratification.

(2) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Test and Evaluation of the demonstration model of a TOSI system will continue. Development efforts to be initiated include [redacted] to insure integrity of the system. Development of [redacted] will be started.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Test and Evaluation of the demonstration model of a TOSI system will continue. Development efforts to be continued include [redacted] to insure integrity of the system. Development of [redacted] will be continued. Cost estimates are Category III Budgetary cost estimates and were updated in September 1987.

(4) (U) Program to Completion: This is a continuing program that will develop technologies applicable to the TOSI effort and provide a demonstration testbed for TOSI evaluation purposes.



(2pp)

C. (U) Major Milestones:

| | Milestones | Dates |
|---|---|---|
| (1) | (U) Component testing; go-ahead for completion of demonstration model | August 1986 |
| (2) | (U) Complete demonstration model; final design of operational test facility | December 1986 |
| (3) | Begin deployment of a Portal Monitoring System in the Soviet Union | |

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604226F
DOD Mission Area: 113 - Airborne Strike

Title: B-1B
Budget Activity: 3 - Strategic Programs

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 115,728 | 366,841 | 221,591 | 0 | 3,576,600 |
| 2731 | B-1B BASELINE | 115,728 | 366,841 | 221,591 | 0 | 3,576,600 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The B-1B is a strategic, long-range, multirole weapon system which is able to perform the missions of conventional bomber, cruise missile launch platform, and nuclear weapons delivery system in both the tactical and strategic roles. Production of the B-1B addresses the national requirements to increase our targeting flexibility, to redress the relative decline of our strategic capabilities, and to revitalize our strategic deterrent forces. The B-1B significantly enchances the manned bomber portion of the strategic TRIAD while preserving the vitally needed flexibility for worldwide nonnuclear force projection in response to unforeseen contingencies. The program was mandated by Congress under Public Law 96-342 and fulfills Strategic Air Command Required Operational Capability 3-66 (Revised), New Strategic Manned Bomber, dated 22 November 1978, and the Long Range Combat Aircraft Mission Element Need Statement, dated 8 June 1981.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 112,840 | 415,511 | 386,726 | 56,814 | 3,793,699 |
| Aircraft Procurement | 0 | 0 | 0 | 0 | 23,696,800 |

(U) EXPLANATION: Flight testing is being extended into FY 1989 to support additional effort needed for the flight control, defensive systems, and cruise missile incorporation. Two new start modifications beyond the baseline were cancelled. The cancellations account for the decrease in RDT&E funding. The new starts, a forward looking infrared sensor and electronic countermeasures updates, were required for expanding needed capabilities and to keep up with the evolving threats.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Military Construction*: (PE 0101126F) | | | | | |
| Funds | 50,000 | 3,600 | 9,160 | 1,190 | 366,210 |

*Military Construction funds are not part of the B-1B acquisition baseline.

PE: 0604226F



(290)

5. (U) RELATED ACTIVITIES: The aircrew training devices and military construction for the B-1B are funded outside the B-1B baseline. These devices (five B-1B weapon system trainers, two mission trainers, six cockpit procedures trainers, and support equipment) will be developed under Program Element 0604227F, Flight Simulator Development. The program will be managed by the Simulator Program Office at Wright-Patterson AFB, OH.

6. (U) WORK PERFORMED BY: The B-1B program is in concurrent full scale development/production. It is managed by the B-1B System Program Office, Aeronautical Systems Division, Wright-Patterson AFB, OH. The B-1B System Program Office has overall integration responsibility for the development of the B-1B bomber. Rockwell International, North American Aircraft Operations, Los Angeles, CA, is the B-1B airframe manufacturer. Rockwell is responsible for achieving aircraft design integrity. Boeing Military Airplane Company, Seattle, WA, is the Avionics Subsystem Interface contractor responsible for integrating the B-1B avionics, and providing avionics equipment not furnished by the government. AIL Division, Eaton Corporation, Deer Park, NY, develops and builds the B-1B defensive avionics system. General Electric Company, Aircraft Engine Group, Cincinnati, OH, is responsible for the design and development of the B-1B propulsion system. Several government agencies provide specialized assistance. For example: The facilities at Holloman AFB, NM, are used to measure radar cross-section characteristics; the wind tunnels at the Arnold Engineering Development Center, TN, are used for comparative analyses; and the Air Force Materials Laboratory and Air Force Avionics Laboratory at Wright-Patterson AFB, OH, are used in the development effort. The majority of the flight test will be done at the Air Force Flight Test Center, Edwards AFB, CA, but several other Department of Defense test ranges will also be used: White Sands Missile Range, NM; Eglin AFB, FL; Point Mugu Naval Air Station, CA; Utah Test and Training Range, UT; China Lake Naval Weapons Center, CA; Nellis Range Complex, NV; and others.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2731, B-1B Baseline:

A. (U) Project Description: The B-1B, a new long range combat aircraft, embodies current advances in aeronautical and countermeasures technologies required to enhance aircraft survivability in projected high threat environments. There is a continuing need for a long-range, large payload, flexible weapon system capable of worldwide rapid power projection.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The first B-1B was placed on continuous alert at Dyess AFB, TX, in October 1986. Crew training continued to be the dominant use of assigned aircraft. Developmental problems with the flight control enhancements and terrain following system were resolved and the system is certified for day-to-day training. Flight control enhancements, defensive system and cruise missile testing continued. Additional weapons certification

was accomplished. Due to the additional testing required, B-1A prototype number four was extended into the first quarter of FY 1987. B-1B number one flew throughout FY 1987. Both were originally planned to complete testing in third quarter FY 1986.

(2) (U) FY 1988 Program: Development and testing efforts, originally planned to be completed before or during FY 1988, will be extended through FY 1988 and into FY 1989. B-1B number one will be extended at least through third quarter FY 1988, B-1B numbers nine and twenty-eight will be extended into FY 1989, and a new test aircraft (number forty) will be added to the test effort and used during FY 1988. The main focus of the FY 1988 development and test effort will be the defensive system, cruise missiles and the flight control enhancement needed to maximize the aircraft's altitude/gross weight potential. Cost estimate is category III, Budgetary.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The development and testing for cruise missile and flight controls capability completes in FY 1989. B-1B numbers nine and twenty-eight complete flight test by second quarter FY 1989. Program Management Responsibility Transfer from Air Force Systems Command to Air Force Logistics Command occurs in FY 1989. Cost estimate is category III, Budgetary. Aircraft 40 will fly as required throughout FY 89 to support the ECM development efforts.

(4) (U) Program to Completion: Not Applicable.

C. (U) Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| (1) | (U) | Defense Systems Acquisition Review Council (DSARC) I | July 1967 |
| (2) | (U) | DSARC II | July 1970 |
| (3) | (U) | DSARC III | December 1976 |
| (4) | (U) | B-1A Production Cancellation | July 1977 |
| (5) | (U) | President Reagan's Strategic Modernization Program | October 1981 |
| (6) | (U) | Full Scale Development Contract Award (Rockwell) | January 1982 |
| (7) | (U) | Full Scale Development Contract Award (General Electric) | February 1982 |
| (8) | (U) | Engineering Review | April 1982 |
| (9) | (U) | Full Scale Development Contract Award (AIL and Boeing) | June 1982 |
| (10) | (U) | Configuration Review | January 1983 |
| (11) | (U) | B-1A number 2 Flight Test Start | March 1983 |
| (12) | (U) | B-1A number 4 Flight Test Start | July 1984 |
| (13) | (U) | B-1A number 2 Flight Test Terminated | August 1984 |
| (14) | (U) | B-1B number 1 Flight Test Start | October 1984 |
| (15) | (U) | B-1A number 4 Flight Test Complete | November 1986 |

| Milestones | Dates |
|---|---|
| (16) (U) B-1A number 9 Flight Test Start | April 1986 |
| (17) (U) Initial Operational Capability (15 aircraft) | September 1986 |
| (18) (U) B-1B number 28 Flight Test Start | March 1987 |
| (19) (U) B-1B number 40 Flight Test Start | January 1988 |
| (20) (U) B-1B number 1 Flight Test Complete | April 1988 |
| (21) (U) Last Aircraft Delivered (100 aircraft) | June 1988 |
| (22) (U) B-1B number 9 and 28 Flight Test Complete | February 1989 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 0604226F, B-1B

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Defense Systems Acquisition Review Council process was completed for the B-1A in December 1976. President Carter cancelled the production and deployment of the B-1A in June 1977.

(U) In July 1980, the United States Congress directed the Department of Defense to vigorously pursue the full scale engineering development of a multirole bomber with an initial operational capability no later than 1987. As a result of that direction, a Joint Air Force/Office of the Secretary of Defense Bomber Alternatives Study team evaluated advanced technology aircraft, the B-1B bomber aircraft and derivatives of the B-1 aircraft and FB-111B/C aircraft.

(U) The General Electric Company was awarded an Initial Full Scale Development (IFSD) contract for a Long Range Combat Aircraft engine in February 1981. The engine was to be common to the aircraft alternatives being evaluated by the Joint Air Force/OSD Bomber Alternatives Study team. On 2 October 1981, President Reagan announced his decision to build 100 B-1Bs. Rockwell International Corporation, Boeing Military Airplane Company, and AIL Division of the Eaton Corporation were awarded their IFSD contracts in October 1981. Subsequent Full Scale Development (FSD) contracts were awarded to Rockwell in January 1982 and to General Electric in February 1982. Boeing and AIL received their FSD contracts in June 1982.

(U) The B-1B program is managed by the B-1B System Program Office. This program is a continuation of the original B-1A effort. Approximately 90 percent of the airframe testing planned for the B-1A was accomplished during the original 6 years of flight test. Further airframe and weapons testing and extensive defensive and offensive avionics testing were required. Examples of this testing include: examination of the improved AN/ALQ-161A defensive suite, integration of the new offensive avionics system, and an evaluation of the new terrain following radar and inertial navigation systems.

(U) The B-1B baseline test and evaluation program contains combined Development Test and Evaluation and Initial Operational Test and Evaluation flight testing which led to an Initial Operational Capability in September 1986.

(U) B-1A number 2, a fully instrumented prototype, was used for stability and control, vibration/acousitcs, dynamic response, propulsion, flutter, and weapon carriage and separation tests. This aircraft began its portion of the B-1 flight test on 23 March 1983. On 29 August 1984, it crashed during a test flight. All unaccomplished tests from B-1A number 2 are incorporated into B-1B numbers 1, 9, and 28 flight test programs.

(U) B-1A number 4, the last operational B-1A prototype, was the primary test vehicle for B-1B defensive and offensive avionic systems. It began its portion of the B-1B flight test program on 30 July 1984. This unique aircraft became nonsupportable and was retired in early FY87.

**Budget Activity:** 3, Strategic Programs
**Program Element:** 0604226F, B-1B

(U) B-1B number 1 is being used to verify previous flutter, stability and control, performance, and weapons separation testing as well as new avionics testing. The aircraft flew its first sortie on 18 October 1984 was originally planned to complete in July 1986. It will be extended to 1988 primarily to complete defensive avionics development.

(U) B-1B number 9 began its flight test effort in April 1986. Its planned testing includes the Stability Enhancement Function. B-1B number 9 is the first cruise missile capable B-1B. It will be used to conduct cruise missile carriage, separation, and launch tests. B-1B number 28 conducted cruise missile integration and flight control testing starting early in 1987. Both aircraft were scheduled to complete in mid FY88, but extensions in FY89 are required due to development delays in flight controls development. The first live B-1B cruise missile launch occurred on 24 November 1987.

(U) B-1B number 40 will be added to the flight test program in FY88 to serve as a dedicated defensive system development asset. The ECM system development program is on a recovery schedule which will complete development and allow fleet retrofit to begin in 1989.

(U) The majority of the flight tests will be done at the Air Force Flight Test Center, Edwards Air Force Base, California, but several other Department of Defense test ranges will also be used: White Sands Missile Range, New Mexico; Eglin Air Force Base, Florida; Point Mugu Naval Air Station, California; Utah Test and Training Range, Utah; China Lake Naval Test Center, California; Nellis Range Complex, Nevada; and others.

(U) The Reliability and Maintainability effort will be directed towards use of a stringent Parts Control Program, Reliability Development/Growth Testing, Burn-In Under Environmental Stress of all production lots, and Reliability Qualification/Production Reliability Tests for selected reliability of safety critical equipment. An extensive central integrated test system (CITS) maturation effort has made significant improvements in CITS performance.

(U) A Program Management Plan Executive Summary for the B-1B program has been submitted to the Deputy Secretary of Defense. The Strategic Air Command System Operational Concept was published in October 1982. A Decision Coordinating Paper, Integrated Program Summary, and Test and Evaluation Master Plan (TEMP), with associated schedules, milestones, cost estimates, and thresholds, were submitted to the Office of the Secretary of Defense (OSD) in November 1983. A revised TEMP was submitted to OSD in April 1987 and was provisionally approved. The extensive restructuring of the B-1 T&E program is reflected in the 1987 TEMP. An ECM test plan was submitted to Congress in February 1988. ECM testing in FY 88 and 89 is primarily developmental.

2. (U) Operational Test and Evaluation (OT&E):

Budget Activity: <u>3, Strategic Programs</u>
Program Element: <u>0604226F, B-1B</u>

(U) The Air Force Operational Test and Evaluation Center (AFOTEC) is assessing the operational effectiveness and suitability of the B-1B. Operational issues and OT&E test objectives have been identified by AFOTEC, with assistance of the Strategic Air Command, for the total OT&E program consisting of combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) and follow-on operational test and evaluation (FOT&E). Those OT&E objectives not sufficiently addressed during the combined DT&E/IOT&E will be addressed during FOT&E(I).

(U) Combined DT&E/IOT&E flight testing began with the initial flight of B-1A number 2 on 23 March 1983, and flight test will continue through March 1989. B-1B numbers 1, 9, 28, and 40 will also be used in the combined test program. B-1A number 2 was lost in August 1984, and B-1A number 4 mothballed in December 1986. B-1B number 28 has been included to supplement ALCM, and B-1B number 40 added for defensive testing. The OT&E evaluation will use all applicable B-1A test data to evaluate the B-1B. Operational suitability testing began during combined DT&E/IOT&E and will extend into FOT&E, since some support equipment will not be delivered until late in the combined DT&E/IOT&E test program.

(U) The areas of special interest in B-1B OT&E testing are survivability, navigation reliability and accuracy, low-level penetration capability, weapons delivery, mission reliability, and diagnostic capability.

(U) Much of the data from the B-1A DT&E/IOT&E flight test are directly transferrable to the B-1B and will not be reevaluated. However, some deficiencies identified in the B-1A DT&E/IOT&E have been corrected in the B-1B and will be reexamined: horizontal stabilizer hinge moment, engine nozzle design, pitch trim rate, flap/slat system, engine start system, flight-control nonlinear gearing, overwing fairings, inertial navigation system, weapon bay door acoustics and vibration, central integrated test system, and fuel leaks.

(U) The program management directive and the test and evaluation master plan specify the OT&E responsibilities of AFOTEC, Strategic Air Command, Air Force Logistics Command, Air Force Systems Command, and Air Training Command.

(U) OT&E reports published:

(U) <u>HQ AFOTEC, B-1A IOT&E Final Report</u>, March 1977 (Secret).

(U) <u>HQ AFOTEC, Manned Bomber Penetration Evaluation Final Report</u>, 30 June 1981 (Secret).

(U) <u>HQ AFOTEC, B-1B Pre-Initial Operational Capability (IOC) Report</u>, August 1986 (Secret).

(U) <u>IOT&E</u>. The 30 June 1985 arrival of offensive avionics software allowed the test team to evaluate operationally representative software. Testing of mission areas such as terrain following (TF), weapon release (simulated), and air alignment was added to the ongoing tests of the aircraft performance, flying qualities, and weapon separation. In January 1987, a short range attack missile (SRAM) was launched by the DT&E team in support of DT&E/IOT&E data needs. In February 1987, a dedicated IOT&E Emergency War Order (EWO) profile sortie was flown to evaluate TF prior to release of TF for SAC training. Common strategic rotary launches and cruise missile integration testing also began in 1987. In

addition, an air-launched cruise missile (ALCM) was launched in November 1987. Although interim defensive configurations have been tested, the defensive system is still in development. The IOT&E suitability effort has been limited to the systems mentioned above. The bulk of the operational suitability data gathering has been shifted to the FOT&E(I) team at Dyess AFB because the base is operationally representative. In summary, all capabilities delivered to the operational forces to date have been verified during IOT&E.

(U) FOT&E. FOT&E(I) is currently conducting a suitability evaluation that will continue through the end of the program. Dedicated FOT&E(I) effectiveness sorties started 1 October 1986 and will run through the end of the test program, March 1989. The FOT&E(I) team uses any SAC aircraft at Dyess AFB. A SRAM was launched by the FOT&E(I) team in June 1987. Operational effectiveness testing is approximately 31 percent complete, exclusive of ECM testing.

3. (U) Systems Characteristics: The B-1B contract specifications have been negotiated. The following required system parameters will be demonstrated during the combined DT&E/IOT&E flight test program now planned to end in 1989. This list represents the test objectives for initial operational capability after the aircraft have been flown for approximately 2,500 flying hours and the characteristics demonstrated as of 31 December 1987. Maturity is defined as 200,000 flying hours and will not be achieved until 1992-93. To date, approximately 12,000 hours have been flown.

| Characteristics | Objectives/Thresholds | Demonstrated |
|---|---|---|
| (U) Technical | | |
| (U) Weight empty (pounds) | 186,000 | 181,400 |
| (U) Operational | | |
| (U) Takeoff distance (feet) (Sea level, standard day, 20 degree wing sweep) | | |
| ( ) 440,000 pound aircraft | | 1/ |
| ( ) 470,000 pound aircraft | | 1/ |
| (U) Sustained speed (Mach number) | | |
| ( ) Best cruise at altitude | | |
| ( ) Penetration (Intermediate power, sea level, standard day) | | |

Budget Activity: 3, Strategic Programs
Program Element: 0604226F, B-1B

| Characteristics | Objectives/Thresholds | Demonstrated |
|---|---|---|
| (U) Payload (Number of weapons) | | |
| (U) AGM-69A (Int) | 24 | 16 3/ |
| (U) AGM-86B (Int/ext) 4/ | 8/12 | 5/ |
| (U) MK-82(AIR)/MK-36DST(AIR) (Int) | 84 | 56 6/ |
| (U) B61/B83 (Int) | 24 | 24 |
| (U) Readiness/Supportability | | |
| (U) Technical | | |
| (U) Built-in Test False Alarm Rate | 5/flight | 2/flight 8/ |
| (U) Central Integrated Test System Fault Detection Rate | 0.90 | 0.90 |
| (U) Operational | | |
| Availability (B-1B System) | [ ] | [ ] 9/ |
| (U) Maintainability (Maintenance Man-hours/Flight Hour)(B-1B System) (Type I Failures) | 80 | 23.4 |
| (U) Meantime Between Unscheduled Maintenance Actions (B-1B System) | 0.22 | .65 |
| Mission Completion Success Probability 7/ | [ ] | [ ] 10/ |

1/ These higher weights cannot be demonstrated without cruise missile carriage. Heavy gross weight flight testing is on hold pending cruise missile heavyweight buildup. Cruise missile employment date is [ ]

2/ Refueled: 1,000 nm low level at 500 nm low level at 0.55 Mach number; 500 nm recovery; 24 Short Range Attack Missile equivalent payload (429,000 pound takeoff weight); KC-135A with 1,000 nm recovery, no external stores/fuel. (Not actually demonstrated in flight.)

3/ (U) SRAM is not certified for use from aft bay pending resolution of pitchdown phenomenon during separation. All certification is complete on forward and mid bays.

4/ (U) The cruise missile test objectives/thresholds are to be demonstrated in FY 1988/FY 1989 testing. A very successful internal launch occurred in Nov 87.

5/ Cruise missile carriage demonstration is limited to 20 total in keeping with arms control policy. Cruise missile employment date is

6/ (U) Conventional testing delayed to support priority certification of nuclear weapons prior to IOC. Testing is ongoing and is scheduled for completion in late Summer 1989.

7/ (U) Mission Completion Success Probability (MCSP) is a measure of system reliability as it affects the mission, excludes factors such as probability of kill, circular error probable, and electronic warfare. MCSP includes Type I, hard failures, only.

8/ (U) Recent software blocks have significantly reduced aircraft false alarms (120/flight to > 2/flight). Offensive and defensive Central Integrated Test System (CITS) maturation is ongoing. Improved ground processing and tech orders are being developed.

9/ (U) Availability has been less than desired due to spare shortages and low reliability on some components. Availability is expected to improve as production ends and fixes to low reliability components are incorporated. SAC is meeting its current training requirements.

10/ The MCSP percentage has increased from at IOC.

4. (U) Current Test and Evaluation (T&E): DT&E: The test team is continuing to evaluate the B-1B avionics and aircraft systems. The primary efforts includes flight controls, cruise missiles, and defensive system evaluations. All capabilities delivered to date have had OT&E involvement in the testing performed.

**Budget Activity:** 3, Strategic Programs
**Program Element:** 0604226F, B-1B

## T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
| --- | --- | --- | --- |
| Combined DT&E/IOT&E Flights (U) | January - December 1987 | January - December 1987 | Edwards AFB, CA<br>B-1B #1 Flight Performance (Avionics, weapons, and flight controls)<br>B-1B #9/28 Air Launched Cruise Missile Testing |
| FOT&E(I) (U) | January - December 1987 | January - December 1987 | Dyess AFB, TX<br>B-1B Suitability and Operational Effectiveness |

## T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
| --- | --- | --- |
| Combined DT&E/IOT&E Flights (U) | January - December 1988 | Edwards AFB, CA<br>B-1B #1 Flight Performance<br>B-1B #9/28 Air Launched Cruise Missile Testing<br>B-1B #40 ECM Testing |
| FOT&E(I) (U) | January - December 1988 | Dyess AFB, TX<br>B-1B Suitability and Operational Effectiveness |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604234F
DOD Mission Area: 113 - Airborne Strike

Title: Common Strategic Rotary Launcher (CSRL)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 12,303 | 5,693 | 946 | 0 | 268,345 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A need exists within the Strategic Air Command to develop and deploy a Common Strategic Rotary Launcher (CSRL) for the B-52H, B-1B and the B-2. The need is for a multipurpose launcher that can accommodate current and future gravity weapons, Short Range Attack Missiles (SRAM), cruise missiles and Advanced Cruise Missiles (ACM). The CSRL will be designed to carry a combination of these weapons on the same launcher load. Initially the CSRL will be integrated into the B-52H to carry homogeneous loads of gravity weapons, SRAM and Air Launched Cruise Missiles (AGM-86B). As the B-52H retires the same CSRLs will transfer along with a conversion kit to the B-1B. The CSRL will be integrated into the B-2 with full mixed carriage capability of B-2 baselined weapons.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 13,120 | 5,715 | 947 | 0 | 271,486 |
| Aircraft Procurement | 83,800 | 73,200 | 56,300 | 73,900 | 358,100 |
| Missile Procurement | 6,165 | 4,732 | 3,683 | 2,663 | 18,543 |

EXPLANATION: (U) The RDT&E reductions reflect both Congressional reductions and reprogramming actions. The procurement reductions totaled $12.7 million. The $14.3 million reduction in FY 1987, the $14.5 million reduction in FY 1988 and the $16.5 million reduction in FY 1990 were all based on execution changes that resulted in reprogramming action. The $4.9 million addition in FY 1989 is needed to support procurement of simulator/training devices.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement (PE 11113F): | | | | | |
| Funds | 69,500 | 58,700 | 61,200 | 57,400 | 311,100 |
| Quantities GpA/GpB | 23/26 | 22/23 | 23/24 | 25/26 | |
| Missile Procurement (PE 11122F): | | | | | |
| Funds | 6,165 | 4,432 | 3,683 | 2,663 | 18,243 |
| Quantities | 26 | 23 | 24 | 26 | |

5. (U) RELATED ACTIVITIES: Common Strategic Rotary Launcher (CSRL) has transitioned from Advanced Development (PE 63258F) to Engineering Development (PE 0604234F). The Air Launched Cruise Missile (ALCM) program (PE 0101122F) provides for the modification/procurement of certain items of ALCM unique support equipment. Specific items include suspended loading checkout frames, CSRL attachment adapters, ALCM ejector alignment fixtures, launcher loader adapters, and electronic system test package sets.

6. (U) WORK PERFORMED BY: The Boeing Military Airplane Company (BMAC), Wichita, Kansas, is the prime contractor and was awarded a contract in June 1983 for launcher full scale development. The development program was awarded to BMAC subsequent to a competitive development effort. Boeing and Rockwell, El Segundo, California, are the respective contractors for integrating the launcher into the B-52H and the B-1B. The Air Force developing organization is the Aeronautical Systems Division of Air Force Systems Command, Wright-Patterson Air Force Base, Ohio.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604234F, Common Strategic Rotary Launcher

A. (U) Project Description: The Common Strategic Rotary Launcher (CSRL) is a multipurpose internal rotary munitions launcher for the B-52H, B-1B and the B-2. The primary purpose of CSRL is to allow the B-52H to carry internal cruise missiles. It will also carry current and future nuclear gravity weapons and Short Range Attack Missiles (SRAM). The CSRL will carry homogeneous loads of these weapons on the B-52H. CSRL is designed to carry a combination of baseline weapons, as well as future conventional weapons, on the same launcher load for advanced bomber applications. As the B-52H retires, the same CSRLs will transfer to the B-1B with a conversion kit. The CSRL improves readiness because it increases munitions delivery flexibility, reduces logistics support structure and provides growth potential for future munitions. The CSRL has also been proven to be the least cost alternative that satisfies the user's requirements. The CSRL program element funds development of the launcher and integration into the B-52H. The B-1B and the B-2 each fund their own launcher integration programs. A roadmap study determined that a common launcher design could be adapted for use on all three bombers. Along with the reduction to a single common launcher design, support equipment was also consolidated so that the Air Force would realize maximum commonality and life cycle cost benefits.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Full rate production of the modified aircraft and the launcher began on time. The physical configuration audit on the first B-52 production article was accomplished. Nuclear certification on the B-52 CSRL was initiated. The flight test program for the B-1B continued on schedule. Development of B-1B field and depot support equipment was terminated.

(2) (U) FY 1988 Program: FY 1988 development efforts will deal with B-1B/CSRL flight testing scheduled to be completed in August 1988. Provide contractor support for B-1B/CSRL flight test and nuclear certification efforts. A parametric estimate based on negotiated prices was used to prepare the request. Cost estimating category is IIB.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 is the final year of RDT&E for the CSRL. Completes nuclear certification efforts and corrects deficiencies identified in B-1B/CSRL flight test. The final year of RDT&E slipped from FY 1987 to FY 1989 due to the crash of B-1A #2, which was the programmed test aircraft.

(4) (U) Program to Completion: Not Applicable

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Full Scale Development (FSD) Contract Award | June 1983 |
| (2) (U) Preliminary Design Review | September 1983 |
| (3) (U) Critical Design Review | March 1984 |
| (4) (U) First FSD Unit Fabrication | July 1984 |
| (5) (U) Start B-52 Flight Test | August 1985 |
| (6) (U) Complete B-52H/CSRL Flight Test | January 1986 |
| (7) (U) Start B-1B Flight Test | May 1986 |
| (8) (U) B-52H Initial Operational Capability | March 1990 |

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604312F
DOD Mission Area: 111 - Land-Based Strike

Title: Intercontinental Ballistic Missile (ICBM) Modernization
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT* | 1,143,499 | 1,068,268 | 1,032,891 | 1,446,300 | 9,091,900 |

* Includes resources in the following categories (Totals may not add due to rounding):

| Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Peacekeeper (Minuteman Silo Deployment) | 290,000 | 36,000 | 40,000 | 35,200 | 6,465,600 |
| Small ICBM | 763,499 | 700,000 | 200,000 | 0 | 3,031,500 |
| Peacekeeper Rail Garrison | 90,000 | 332,268 | 792,891 | 1,411,100 | 2,626,300 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The military need for ICBM modernization stems from the requirement to respond to Soviet ICBM developments which are causing a major imbalance between the United States and Soviet strategic capabilities. The overall mission of the ICBM modernization program is to support the U.S. strategic deterrent policy while responding to changes in the projected Soviet threat and target base. The modernization program is built on the recognition that all ICBM tasks cannot be served by a single missile or a single basing mode. The near-term response--deploying 50 Peacekeeper in Minuteman silos--will reduce the Soviet advantage in ICBM capability and help deter a broad spectrum of potential threats including massive conventional or limited nuclear attack on the United States or our allies. The long-term response includes deploying Peacekeeper missiles in Rail Garrison.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| | | | | TBD | TBD |
| RDT&E | 1,547,407 | 2,875,728 | 3,461,672 | 0 | 84,200 |
| Aircraft Procurement | 25,600 | 19,900 | 0 | 4,705,465 | 14,176,132 |
| Missile Procurement | 1,136,599 | 1,276,884 | 1,361,085 | 253 | 6,591 |
| Other Procurement | 147 | 349 | 284 | | |

EXPLANATION: (U)

(U) RDT&E: Net decrease in FY 88 is due to Congressional cuts in both the Small ICBM ($2.2 billion requested to $700 million appropriated) and Rail Garrison ($591 million requested to $350 million appropriated) programs. FY 89

PE: 0604312F

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Program Element: 0604312F
DOD Mission Area: 111 - Land-Based Strike

Title: Intercontinental Ballistic Missile (ICBM) Modernization
Budget Activity: 3 - Strategic Programs

Small ICBM reductions reflect the Department's position to descope the program. However, $200 million is requested in
order to keep the option open for a new Administration to decide whether or not to continue the program. The FY 1989
RDT&E reduction for Rail Garrison incorporates updated estimates from recent contract experience. The basing, test and
system support contract has been awarded and savings realized with this contract are incorporated in this request.
Updated estimates for the missile launch car and launch control car are incorporated. Revised RDT&E estimates provide
resources required to meet directed schedule.

(U) Missile Procurement: FY 1988 funds reflect Congressional reduction from 21 to 12 missiles and Congressionally
directed undistributed reductions. Decrease in FY 89 reflects a reduced request from 21 to 12 missiles consistent
with Congressionally authorized production rates of 12 missiles per year in FY 86-88.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Program Element 0101215F (Peacekeeper Squadrons) | | | | | |
| Aircraft Procurement: (Airborne Launch Control Center Mod Kits) | | | | | |
| Funds | 25,600 | 19,900 | 0 | 0 | 84,200 |
| Quantities | 8 | 6 | 0 | 0 | 22 |
| Missile Procurement: | | | | | |
| Funds | 1,136,599 | 873,700 | 808,700 | 6,823,70C | 15,233,300 |
| Quantities | 12 | 12 | 12 | 145 | 235 * |
| * Contains 12 test missiles for Rail Garrison operational testing and evaluation | | | | | |
| Other Procurement: (Flight/Ground Test Support) | | | | | |
| Funds | 147 | 349 | 284 | 253 | 6,591 |
| Quantities | N/A | N/A | N/A | N/A | N/A |
| Military Construction | | | | | |
| Funds | 25,900 | 9,100 * | 44,400 * | TBD | TBD |

* Contains $3.5 million in FY 88 and $44.4 million in FY 89 for construction necessary to test the Rail Garrison concept at F.E. Warren AFB.

5. (U) RELATED ACTIVITIES: This program is directly related to efforts in the programs for Peacekeeper Squadrons (PE 0101215F), Small ICBM Squadrons (PE 0101219F), and Advanced Strategic Missile Systems (PE 0603311F). This program and the related programs are all managed within the Ballistic Missile Office, thus assuring close coordination.

PE: 0604312F

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PE 0101215F contains funding for both Peacekeeper military construction and missile procurement. PE 0101219F contains funding for Small ICBM military construction and missile procurement.

6. (U) WORK PERFORMED BY: The program is managed by the Ballistic Missile Office, Norton Air Force Base, CA. Facilities at Arnold Engineering Development Center, Tullahoma, TN, are used for motor testing and facilities at the Central Inertial Guidance Test Facility at Holloman AFB, NM, are used for guidance testing. Flight testing is conducted at Vandenberg AFB, CA. The top five ICBM Modernization Program contractors are Martin Marietta Aerospace, Denver, CO (Assembly, Test and Systems Support; Peacekeeper Support Equipment); Boeing Aerospace, Seattle, WA (Basing Operational Support, Hard Mobile Launcher, Rail Garrison Basing, Test, and System Support); Rockwell International Rocketdyne Division, Canoga Park, CA (Guidance and Control); Northrop Electronics Division, Hawthorne, CA (Inertial Measurement Unit); and AVCO, Wilmington, MA (Reentry Vehicle/Reentry System). The total dollar value of current R&D contracts is $6.9 billion.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989:

(U) Project: 0604312F, ICBM Modernization

A. (U) Project Description: In October 1981, the President initiated the U.S. Strategic Modernization Program to counter growing Soviet threats to U.S. strategic systems. Congress subsequently directed further study of survivable ICBM basing concepts in the FY 1983 Continuing Resolution. In response, the President formed the Commission on Strategic Forces (Scowcroft Commission) to review strategic force modernization with special focus on ICBM systems. In April 1983, the Commission submitted its recommendations, which were endorsed by the President and later approved by the Congress. The following describes the three elements of the resultant ICBM Modernization Program. Peacekeeper. The Peacekeeper missile system entered full-scale development in September 1979. Current major areas of effort include production of missile and basing subsystems, system integration and extensive testing to support the production design. The missile subsystems include an advanced guidance set derived from the Advanced Inertial Reference Sphere (AIRS) prototype. The three solid propellant boosters use a lightweight motor case. For increased system performance, stages two and three have advanced nozzles and stage three uses a high energy propellant. The Peacekeeper reentry vehicle (RV) is the Mark-21. Basing development includes modification of the existing Minuteman silo design and launch control system and development of ground support transportation/handling equipment. Related military construction efforts include modification or construction involving facilities at Vandenberg AFB, CA, to support missile flight testing; facilities at F.E. Warren AFB, WY, for deployment and operation of the system in 50 Minuteman silos at the 400th Strategic Missile Squadron; facilities at Hill AFB, UT, to enable logistics support of the system; and facilities supporting the airborne launch control operations at Ellsworth AFB, SD, and Offutt AFB, NE. Small ICBM. The underlying logic for this recommendation of the Scowcroft Commission was that a Small ICBM could provide long-term survivability and, with a single reentry vehicle, would present a relatively low-value target. Properly based, a Small ICBM would be highly stabilizing and would enhance the arms control process. The President and the Congress concurred with this recommendation, and the Office of the Secretary of

Defense directed the Air Force to vigorously pursue the development of the Small ICBM. The Air Force established a Deputy for Small ICBM at the Ballistic Missile Office (BMO) to be responsible for the development and acquisition of the Small ICBM and basing technology. The Air Force also convened the Small Missile Independent Advisory Group (Schriever Group) to recommend an acquisition strategy and management approach for the program. The Air Force has implemented the Schriever Group's recommendations and is currently in full scale development. The "baseline" Small ICBM weapon system builds on Peacekeeper technology. The missile will weigh approximately 37,000 pounds and have a range of over 6,000 nautical miles. It will be cold-launched and consist of three solid propellant stages placed in a hardened mobile launcher. On 19 December 1986, the President directed that the Small ICBM be placed into full scale development leading to an initial operational capability (IOC) of 1992. Budgetary constraints have made it necessary to reduce the scope and effort of the Small ICBM in FY 89. Peacekeeper Rail Garrison. As recognized by the Congress, the development of technology applicable to the future U.S. ICBM force could provide great diversification and survivability. The Department of Defense has conducted an extensive study on the potential advanced basing technologies hold for future ICBM deployments. The result of this study was the President's decision, in December 1986, to begin development of Rail Garrison as a highly survivable and flexible basing mode for deployment of additional Peacekeeper missiles.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Peacekeeper. Flight test seventeen was successfully conducted in March 1987. The final three of twenty scheduled RDT&E flight tests will be completed in FY 1989. The Program Office continued the development of a second source for the Guidance System Inertial Measurement Unit (IMU) for future competition beginning with the FY 1988 buy. The FY 1987 Military Construction Program (MCP) consisted of two projects at Hill AFB and four projects at F.E. Warren AFB. Depot support was activated at Warren, Hill and Kelly AFBs. Automatic Test Equipment was delivered to Newark AFS, OH, to support the guidance system. Small ICBM. Full scale development (FSD) began in FY 1987. In December 1986, FSD contracts for propulsion and the HML were awarded. Flight tests of competing Advanced Inertial Reference Sphere (AIRS) on Peacekeeper missiles and Alternate Inertial Navigation System (AINS) on Minuteman III missiles were conducted. Weapon system nuclear hardness and survivability tests and analyses were also conducted. Continued development of the missile stages by FSD winning contractors, including static firings, continued in support of a first flight in FY 1989. The Weapon Control System (WCS) contractors were downselected to a single contractor; hardware and software detail design progressed. The Hard Mobile Launcher contractor continued mobility and hardness studies and initiated FSD design. Two cold launch demonstrations have successfully been conducted. Peacekeeper Rail Garrison. FY 87 work included system concept development, system requirement analysis and test and evaluation planning. Downselection to 11 candidate basing installations (all Air Force bases) was accomplished. In September, the Basing Test & System Support (BT&SS) contract was awarded.

(2) (U) FY 1988 Program : Peacekeeper. The RDT&E program includes continued flight testing data reduction/analysis and support for Strategic Air Command Follow-on Test and Evaluation flights. This allows the Air Force to remain postured to accommodate any changes identified during deployment. Procurement of 12 missiles is planned. A second source contract was awarded to Rockwell Autonetics for production of the IMU beginning in FY 1988. The FY 1988 Military Construction Program will include two projects at Hill AFB. Small ICBM. FSD will

continue through FY 1988 with Preliminary Design Reviews held for the missile, Hard Mobile Launcher and the Weapon Control System. The first, inert Small ICBM will be delivered to Vandenberg AFB, CA, for electrical and mechanical checkout. Hardware and integration checkout will begin for Flight Test Missile 1. Peacekeeper Rail Garrison. Development is continuing to refine the Rail Garrison concept and will provide a foundation for an FSD decision by the Defense Acquisition Board (DAB) in March 1988. Upon approval of this decision, the Missile Launch Car (MLC) and the Launch Control Car (LCC) contracts will be awarded. Areas of development include test planning, technology validation and integration of software and hardware. System design reviews will be conducted on all subsystems, such as individual rail cars and the launch control system. Existing Peacekeeper missile production contracts will be modified to provide Basing Verification Missiles (BVM) test assets. Environmental impact analysis is also slated.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Peacekeeper. Deployment of the 50th Peacekeeper in Minuteman silos is scheduled for December 1988. RDT&E is required to accommodate any changes identified during completion of deployment or as a result of flight test data analysis. Specific RDT&E requirements include nuclear hardness testing and engineering support. Small ICBM. The FY 89 amended President's budget will contain $200 million which will allow the Air Force to maintain some contractor force in place and to continue minimum missile and basing development efforts. Peacekeeper Rail Garrison. Development of Rail Garrison continues to include prototyping of subsystems and preliminary design reviews. Engineering and preliminary operational models will be fabricated for developmental testing and initial system integration testing. Environmental impact analysis will be completed resulting in release of the Environmental Impact Statement (EIS). Military construction is necessary in order to test the Rail Garrison concept at F.E. Warren AFB.

(4) (U) Program to Completion: Peacekeeper. Missile production is projected to continue through the FYDP. Small ICBM. Budgetary constraints have forced termination of Small ICBM. The FY 89 President's Budget contains $200 million in order to keep the options open for a new Administration to decide whether or not to continue the program. Peacekeeper Rail Garrison. Development will continue on Rail Garrison with a goal of presenting Congress with a cost effective option to increase our deterrent posture.

C. (U) Major Milestones:

| | | Peacekeeper Milestones | Dates |
|---|---|---|---|
| (1) | (U) | Strategic Air Command Required Operational Capability 16-71, Advanced ICBM System | February 1972 |
| (2) | (U) | Defense Systems Acquisition Review Council I | March 1976 |
| (3) | (U) | Validation Phase Initiated | October 1976 |
| (4) | (U) | Defense Systems Acquisition Review Council IIB | July 1979 |
| (5) | (U) | Full-Scale Development Initiated | September 1979 |
| (6) | (U) | System Design Review | September 1980 |
| (7) | (U) | President's Strategic Modernization Program Announced | October 1981 |
| (8) | (U) | Scowcroft Commission Recommendation/Presidential Decision | April 1983 |

| | | Peacekeeper Milestones (Cont.) | Dates |
|---|---|---|---|
| (9) | (U) | First Flight Test | June 1983 |
| (10) | (U) | Nuclear Hardness and Survivability Review Group Convened | October 1983 |
| (11) | (U) | Production Start | January 1984 |
| (12) | (U) | First Silo Launch | August 1985 |
| (13) | (U) | Initial Operational Capability (IOC) | December 1986 |
| (14) | (U) | Deployment Completed for 50 missiles | December 1988 |

| | | Small ICBM and Hard Mobile Basing Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Scowcroft Commission Recommendation | | April 1983 |
| (2) | (U) | Small ICBM Program Office Established | | May 1983 |
| (3) | (U) | Schriever Group Recommendation | | September 1983 |
| (4) | (U) | Nuclear Hardness and Survivability Review Group Initiated | | October 1983 |
| (5) | (U) | Pre-Full Scale Development Start | | October 1984 |
| (6) | (U) | Full-Scale Development Start | | December 1986 |
| (7) | (U) | System Design Review | *(1 Qtr CY 1988) | TBD |
| (8) | (U) | First Flight Test | *(1 Qtr CY 1989) | TBD |
| (9) | (U) | Production Start | *(4 Qtr CY 1989) | TBD |
| (10) | (U) | Initial Operational Capability | *(December 1992) | TBD |

* Date presented in FY 1988/1989 Descriptive Summary.

| | | Alternative Basing Technology/Peacekeeper Rail Garrison Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Initial Nuclear Environment Definition | | Mid-1983 |
| (2) | (U) | Initial Concept Phase for Deep Basing Completed | | September 1983 |
| (3) | (U) | Nuclear Hardness and Survivability Review Group Convened | | October 1983 |
| (4) | (U) | OSD Deep Basing Requirements Study Completion | | March 1984 |
| (5) | (U) | First Egress Subsystem Demonstration for Hard Silo | | February 1985 |
| (6) | (U) | Follow-on Basing Decision | | December 1986 |
| (7) | (U) | Defense Acquisition Board Review (Milestone II) | (New) | March 1988 |
| (8) | (U) | Full Scale Development (FSD) | (New) | April 1988 |
| (9) | (U) | System Design Review (SDR) | (New) | May 1989 |
| (10) | (U) | Preliminary Design Review (PDR) | (New) | March 1990 |
| (11) | (U) | Critical Design Review (CDR) | (New) | March 1991 |
| (12) | (U) | First Basing Verification Missile (BVM) launch | (New) | March 1991 |
| (13) | (U) | Initial Operational Capability (IOC) | (New) | December 1991 |
| (14) | (U) | Full Operational Capability (FOC) | (New) | TBD |

(U) Explanation of Milestone Changes

Small ICBM and Hard Mobile Basing

(7),(8),(9),(10) (U) FY 84 Authorization Act directs IOC for Small ICBM in 1992. Current funding constraints do not support achieving this date, nor milestones leading to the date.

Peacekeeper Rail Garrison

(7-14) (U) These new milestones resulted from the President's December 1986 decision to begin development of Peacekeeper Rail Garrison as a future basing mode for Peacekeeper missiles.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Ballistic Missile Office (BMO), Norton AFB, CA, is the Air Force Program Manager for developing the Peacekeeper Weapon System. BMO is also the Responsible Test Organization for DT&E. The Air Force Operational Test and Evaluation Center is responsible for initial operational test and evaluation (OT&E). The Strategic Air Command will operate Peacekeeper and will, jointly, with the Air Force Logistics Command be responsible for maintaining the system. Principal development contractors are: Aerojet General Corporation, Avco Systems Textron, General Electric Company, Goodyear Aerospace Corporation, GTE Strategic Systems Division, Hercules Aerospace Corporation, Honeywell Incorporated, Logicon Incorporated, Martin Marietta Corporation, Morton-Thiokol Incorporated, Northrop Corporation, Rockwell International - Autonetics Strategic Systems Division, Rockwell International - Rocketdyne Division, TRW, The Boeing Company, Westinghouse Electric Corporation.

(U) The Peacekeeper in Minuteman Silos DT&E program to date has concentrated primarily on the development and test of missile subsystems, reentry vehicle development, and silo integration, and on weapon system performance with seventeen successful flight tests. Flight testing from a modified Minuteman launch facility, as prescribed in the program basing system concept, has begun. DT&E testing reported herein summarizes activity of the first seventeen flight tests of Peacekeeper flight test missiles (FTM) and the significant basing hardware and software system tests.

(U) Twenty DT&E test flights from the Western Test Range at Vandenberg AFB (VAFB), CA, have been scheduled. These development test and evaluation/initial operational test and evaluation flight tests will be followed by 108 follow-on operational test and evaluation flights conducted by the Strategic Air Command. The flight test articles will be configured with instrumented reentry vehicles and an instrumentation and flight safety system. The test and evaluation objectives are to evaluate missile performance including Peacekeeper stage II and III motor extendible nozzle exit cone capability to survive and perform during actual Peacekeeper missile powered flight; and to assess the capability of the advanced inertial reference sphere guidance and control units to achieve accuracy and reliability, including ground system operational interface, stage performance, guidance and control accuracy, post boost vehicle footprint, and time of flight performance capabilities. The first eight launches were from a test pad to evaluate the missile. The last twelve launches will be from modified Minuteman launch facilities. The ninth launch was the first conducted from a modified Minuteman silo using operational ground and flight programs, while being controlled from a Minuteman launch control facility. Major emphasis focused on the integration testing of ground support systems, with continued emphasis on missile subsystems. Future flight tests will focus increasingly on weapon system performance and operational system verification. To date, there have been seventeen successful flight tests and the eighteenth, nineteenth and twentieth flight test missiles are in processing and checkout

at Vandenberg AFB (VAFB). The current Peacekeeper DT&E flight test program has been restructured to extend completion of the program out to the first quarter of calender year 1989.

(U) The test data thus far has provided confidence that the required weapon system performance can be met within the identified state-of-the-art technologies at a reasonable cost. Additionally, this testing has provided hardware design data which will assure more comprehensive specifications and a more realistic estimate of life cycle system costs. The test program initially evaluated areas of design risk in guidance, motor and nozzle, reentry system, launcher, command control and communication, ground power, physical security system, and nuclear hardness and survivability. Contractor test facilities, Arnold Engineering Development Center, Tullahoma, TN; Astronautics Lab, Edwards Air Force Base, CA; Nevada Test Site, Mercury, NV; Holloman Air Force Base, NM; Kirtland Air Force Base, NM; Hill Engineering Test Facility (HETF), Hill Air Force Base, UT; Hunters Point Naval Station, CA; and Vandenberg AFB, CA, have been used for most of the testing to date.

DT&E on guidance and control (G&C) during full-scale development (FSD) is currently emphasizing performance (functional and accuracy) testing of missile subsystems in a benign flight environment. All airborne vehicle and ground support equipment was tested, prior to flight, during the pathfinder testing at Vandenberg Air Force Base. Ground testing culminated in an end-to-end polarity test of the missile system. Flight missile guidance and control sets (MGCS) for the FTM-1 through FTM-17 tests completed acceptance testing at the contractor and were delivered to VAFB where they successfully completed pre-launch and flight test. Data analysis indicates excellent performance by sixteen of the seventeen guidance systems. The mean point of impact (down, cross) for each of the first seventeen flight tests are as follows:

The test range accuracy is

(U) Guidance and control tests completed to date include vibration, shock, temperature, attitude, electromagnetic compatibility, TEMPEST, and integration testing. Tests required to identify potential improvements for the MGCS operational mechanization were completed in FY 1984.

(U) FY 1985 and FY 1986 full scale development testing activities included flight tests, qualification tests, and interface tests. The launch control system controller with its new controlling software, the interfaces with a modified programmer group at the launch facility, and modified software at the launch control facility were integrated for the first time on FTM-9. Flight testing of the guidance system using operational ground and flight computer programs began with FTM-9 and continues on subsequent flights. New routines for calibration and alignment

will also be tested during this portion of the flight test program. The mechanization and accuracy of these new routines have been verified during sled test environmental runs performed at Holloman AFB in FY 1984 and early FY 1985. Additional sled test runs were accomplished in late FY 1985 to demonstrate the mechanization and accuracy capabilities of the actual flight computer programs. Activities to reduce the time required for the calibration and alignment sequence will continue in FY 1988. Radiation and mechanical qualification tests will be performed on the missile electronics and computer assembly (MECA), the inertial measurement unit and the missile guidance and control set (MGCS). Guidance and control (G&C) subsystem interface testing with basing equipment began in FY 1985 and continues into FY 1988. Preliminary tests will be performed at contractor facilities with final checkout to be accomplished at Vandenberg and Francis E. Warren AFBs.

(U) Stage I is a solid propellant rocket motor that is 28 feet long, 92 inches diameter, and weighs approximately 107,000 pounds. It has a thrust vector actuation system that can vector the nozzle up to six degrees. Stage I boosts the missile to about 75,000 feet following cold launch from the canister.

(U) Stage II is a solid propellant rocket motor that is 18 feet long, 92 inches diameter, and weighs approximately 60,000 pounds. It has a thrust vector actuation system that can vector the nozzle up to six degrees, and an extendible nozzle exit cone (ENEC) that is deployed after stage ignition to increase performance at operating altitudes. Stage II boosts the missile from approximately 75,000 to 300,000 feet.

(U) Stage III is a solid propellant rocket motor that is 90 inches long, 92 inches diameter, and weighs approximately 17,000 pounds. It has a thrust vector actuation system that can vector the nozzle up to three degrees, and an ENEC that is deployed after stage ignition to increase performance at operating altitudes.

(U) Stage IV is a liquid propellant stage with one axial rocket engine and eight attitude control thrusters. Stage IV is 42 inches long, 92 inches diameter, and weighs approximately 2,500 pounds. The axial engine can be vectored up to 15 degrees.

(U) First Flight (17 June 1983) data review revealed several anomalies in stage I and stage II.

(U) Stage I experienced an excessively long (440 versus 250 milliseconds expected) time for chamber pressure to build up and a long tail off time. The cause of the ignition delay was excessive moisture on the propellant grain. The long tail off was due to a propellant casting anomaly. To eliminate the slow pressure rise the launch eject gas generator (LEGG) was modified and an igniter moisture protection cover was incorporated. To eliminate the long tail off, propellant casting processes were reviewed, the source of the anomaly identified, and strict process controls levied to prevent recurrence.

(U) Stage II experienced an ENEC anomaly which was attributed to an improper locking device on the ENEC actuation system. A fix was implemented on FTM-2, to incorporate sufficient locking force. Stage II ENECs have performed satisfactorily on all subsequent missions.

(U) The second flight test (14 October 1983) with the modified launch eject gas generator (LEGG) was conducted at Vandenberg Air Force Base, (VAFB), revealing improved (390 milliseconds) stage I ignition and stage II extendible nozzle exit cone (ENEC) operation. The stage I pressure rise time has proven highly repeatable on all flights and is within system requirements. The stage I prime item development specification (PIDS) was revised to reflect the slower ignition time.

(U) The third flight (20 December 1983) experienced an ENEC failure at approximately 27 seconds into stage III operation. The failure was attributed to loss of the heat shield that protects the ENEC deployment actuator from heat from the cone. Subsequently Hercules has added additional insulation to the actuator and has strengthened the heat shields to prevent loss. These corrections are for flight test missile 4 (FTM-4) and up. The fourth flight (30 March 1984), fifth flight (15 June 1984) and sixth flight (1 October 1984) experienced no ENEC problems.

(U) The fifth flight (15 June 1984) expended stage I motor case was successfully recovered and examined. Data showed normal nozzle erosion, but higher than normal internal insulation erosion in the forward dome area. The stage I motor case from the seventh flight was also recovered and examined with consistent results. The internal insulation was redesigned by thickening the insulation in the affected area beginning with FTM-9. An internal helium regulator leak was experienced on stage IV during FTM-5 flight. The cause was judged to be a failure of the upstream filter. The filter was redesigned and no further problems of this nature have occurred.

(U) The seventh flight (1 February 1985) experienced an ENEC failure at approximately 20 seconds into stage III operation. The failure was attributed to structural failure of the forward ENEC cone. The forward cone has subsequently been strengthened by the addition of a support ring; several other design modifications have been made to reduce loads on the forward cone. These corrections have been made for FTM-8 and up. The modifications have been successfully tested on two firings at Arnold Engineering Development Center (AEDC) and on ten flight tests, FTM-8 through FTM-17.

(U) The ninth flight (23 August 1985) was the first launch from a modified Minuteman launch facility utilizing a redesigned LEGG. Stage I ignition delay dropped to 260 milliseconds as expected.. After flight, the expended stage I motor case was recovered and examined. Insulation data showed the redesign to be adequate and nozzle data to be consistent with earlier flights. No further motor case recoveries are planned.

(U) The fifteenth flight (5 December 1986) experienced a stage IV early fuel depletion and failed to successfully deploy the last three reentry vehicles on the mission. The cause of the failure was a restriction (nylon cloth) in the oxidizer pressurant manifold. Corrective action includes additional visual checks, manifold tests and acceptance test procedures on stage IV motors.

(U) Stage I has completed a four motor flight proof test program, a four motor pre-qualification test program and eight qualification motor firings. All stage I test firings are conducted at sea level; the other three stages use a mix of sea level testing and simulated altitude testing at AEDC or contractor facilities. All flight proof,

pre-qualification and qualification stage I test motor firings have been completed. In addition, the first two production quality assurance (PQA) motor firings were successfully completed 10 July 1986 and 25 April 1987.

(U) Stage II has completed four flight proof test (FPT) motor altitude firings at AEDC. FPT-1 fired successfully, followed by the FPT-3 failure. The failure mode was identified and solved by trimming propellant in the forward and aft boot areas to relieve restricted gas flow. DS-7A and DS-7B were successfully tested at sea level at Aerojet Strategic Propulsion Company (ASPC) verifying a hand-trimmed grain to be used on first flight. DS-10 and DS-10A were also successfully tested at ASPC, verifying the as-cast grain configuration and a new liner system. The firing of DS-8 at Arnold Engineering Development Center (AEDC) demonstrated the adequacy of the alternate low density carbon ENEC cone material. FPT-2 successfully fired at AEDC, verifying the as-cast grain configuration and new liner system at altitude. Flight proof test 4 (FPT-4) successfully completed the FPT motor test series at AEDC and verified the grain at cold temperature. The sixth flight test (1 October 1984) was successfully conducted at Vandenberg Air Force Base (VAFB), verifying the as-cast grain configuration. In addition to the FPT program, stage II has also completed a three motor pre-qualification program and has successfully tested seven qualification motors at AEDC. All flight proof, pre-qualification and qualification stage II test motor firings have been completed. In addition, the first two PQA motor firings were successfully completed 23 January 1987 and 19 June 1987.

(U) Stage III has completed five successful FPT motor altitude firings in the J-5 test cell at AEDC. Hercules has also completed three successful pre-qualification firings at their Tekoi facility and five successful qualification tests at AEDC prior to the qualification test motor number four (Q-4) failure in the J-5 test cell at AEDC on 23 November 1985. The failure mode was identified as a weak propellant liner-to-insulator bond, which subsequently led to case burn through and rupture. To correct this failure mode, additional insulation was added and tighter production process controls were implemented for liner applications. These corrective actions were incorporated into pre-qualification test motor four-alpha (Q-4A), which was successfully tested at Tekoi on 30 April 1986. In addition, a sixth successful qualification test (qualification test motor number eight) was fired at Tekoi on 26 February 1986. Although this firing occurred after the qualification test motor number four failure and after identification of corrective actions, qualification test motor number eight did not include the corrective actions due to program schedule constraints. All flight proof pre-qualification and qualification Stage III test motor firings have been completed. In addition, the first two PQA motor firings were successfully completed on 31 January 1987 and 29 June 1987.

(U) The stage IV FPT program for both screen and bladder tank designs was completed by the successful firings of FPT-1, FPT-2, FPT-3 and FPT-3-R1 (screen tank design). These tests demonstrated flight proof design review design and the flight worthiness of the system. Stage IV has also had two successful pre-qualification firings and three successful qualification firings at AEDC. The first flight test of the screen tank was successfully completed on FTM-9. All flight proof, pre-qualification and qualification stage IV test motor firings have been completed. In addition, the first PQA motor firing was successfully completed on 18 February 1987.

(U) The ordnance system has successfully completed both Flight Termination Ordnance System (FTOS) qualification and Ordnance Initiation Set (OIS) flight proof testings. FTOS and OIS deliveries for test flights 1-20 and OIS deliveries for the initial production buy have been accomplished. The OIS second source program has been successful. The hardware will be used for the third production buy.

(U) The reentry system flight proof testing has been completed successfully at the subassembly and system level. Reentry system performance in flight tests 1 through 9 was nominal in all cases, except for an FTM-9 fuze anomaly which continues to be evaluated. The electronics package for the reentry system has been modified to accommodate both operational MK 12A and MK 21 reentry vehicles. Flight proof testing for the MK 21 was conducted during FY 1984 and qualification testing was conducted during FY 1985. MK 21s were flown on FTM-5 through FTM-14 with good results.

(U) The only major subsystem that will not be completely tested as an entity is the nuclear warhead. The Department of Energy (DOE) will manage this testing in the same manner that they test other nuclear weapons. The DOE will certify yield and reliability. These figures will be used by the military along with other test data to assess weapon system effectiveness.

(U) The canister development test program began January 1982 using a composite canister at the Nevada Test Site. The initial canister assembly launch test program (CALTP) test series consisted of five launches. This series generally validated the cold launch test technique for use in the Phase I flight test program. Improvements to the launch eject gas generator and canister-to-missile pad attachment technique were made to correct anomalies discovered during these development tests.

(U) A second series of five canister assembly test program (CALTP) launches was initiated in May 1984 to confirm hardware specifically designed for the Peacekeeper in Minuteman Silos basing mode. Four of the five planned launches in this series were completed by June 1985. These tests focused on performance of the pre-production hardware, assessment of the gas dynamic conditions in the simulated upper silo area and pads retension release system. All objectives of the test series were completed with four launches, allowing the cancellation of the fifth test.

(U) Integrated mechanical system development testing was conducted at Vandenberg Air Force Base (VAFB) LF-05 between January and April 1985. These tests successfully validated the Peacekeeper emplacement concept using the emplacer and air elevator. The mechanical systems equipment has now successfully supported transport to VAFB, stage processing, missile assembly, transport to the launch pad for FTM-1 through FTM-8 and missile emplacement in VAFB LF-02, LF-05, and LF-08. These systems will continue to support testing at all Peacekeeper processing and launch facilities.

(U) The Peacekeeper unique environmental control system modifications required in the Minuteman silos were tested in VAFB LF-05. Initial results indicate the system will meet all requirements. Detailed verification of these results through thermal modeling has been completed.

(U) Vertical and lateral shock isolation testing has also been conducted at the manufacturer's plant. The tests were performed by simulating the loading these systems would experience in a nuclear shock environment. The test results confirmed that the vertical shock isolators and lateral foam blocks performance is satisfactory.

(U) Electrostatic effects mitigating hardware, part of the operational model lateral support group, was successfully tested as prototype hardware on FTM-12 and then as weapon system configuration approved hardware on FTM-15.

(U) Integrated electrical system development testing was conducted at Peacekeeper development test sites (DTL-Seattle and DTL-Vandenberg AFB) and LF-05. The DTLs contain launch facility and launch control facility engineering model hardware which was successfully integrated from both a hardware/hardware and a hardware/software perspective. Peacekeeper operational executive program and the launch control program development program supported the FTM-9 flight test and will continue to be developed and integrated until operational software is available. The flight test missile 9 (FTM-9) software was successfully exercised in LF-05 prior to FTM-9, resulting in additional confidence in the software development program. Starting with FTM-15, operational ground electronics will be used for the DT&E flight tests.

(U) A nuclear hardness and survivability test program of missile materials, components, and subsystems has been ongoing since 1977 when external protection material testing began. This program was completed in 1984. The underground test program consisted of Miners Iron (1980) tests on materials for booster and reentry system, Huron Landing (1982) tests on missile structures and shroud, and MK 21 reentry vehicle testing on Midas Myth (1984), Misty Rain (1985), and Mighty Oak (1986). In 1983 (January-June) an electromagnetic pulse (EMP) test of the Peacekeeper missile was carried out at the advanced research electromagnetic pulse simulation facility in New Mexico. A follow-up EMP test of a Peacekeeper with a functional missile guidance and control set was completed in October 1986. The light initiated high explosive test was run on Stage IV in 1983. MK 21 reentry vehicle airblast and x-ray impulse simulation tests were completed in September 1985.

(U) In support of the Peacekeeper in Minuteman Silos system development, there were a large number of tests in the late 1984, early 1985 time period. One such test was a shock isolation system (ground shock) test. This test supported a November 1984 critical design review. An electrical surge arrester vault test (EMP) was completed in October 1986. In addition, a number of components and subsystems have been or will be tested for EMP, radiation, and/or mechanical environments. All such testing was completed by September 1987. The test demonstrated adequate survival margins.

(U) A Class II development test of the common airborne launch control center (ALCC) system was conducted between April and August 1985, with a series of ground tests and four flight tests. Engineering models were tested to assess fulfillment of design requirements and verification of interface compatibility. Successful hardware integration tests were completed and flight tests were conducted over the DTL-S, LF-08, and Hill Engineering Test Facility. The performance of the Class II development test program enabled a favorable modification review group decision to proceed with initial operational capability testing which took place from March to June 1987 using operational

hardware and airborne operational program (AOP) software. The initial operational capability (IOC) testing was highly successful. The AOP will include full launch capability for both Peacekeeper and Minuteman weapon systems. Peacekeeper targeting and status uplink capabilities will be tested in March/April 1988 against a ground test missile at Vandenberg Air Force Base. FTMs 18, 19, and 20 will be airborne launch control center (ALCC) launches.

(U) Tests on the following subsystems have been scheduled, started, and/or completed as shown:

| Test | From | To |
|---|---|---|
| Ordnance Initiation Set | Jun 80 | Sep 85 |
| Flight Termination Ordnance System | Aug 80 | Oct 84 |
| Flight Software | Jan 81 | Dec 82 |
| Advanced Inertial Reference Sphere Sled | Jun 81 | Sep 81 |
| Advanced Inertial Reference Sphere Bench | Sep 81 | Sep 82 |
| Reentry System Shock and Vibration | Oct 81 | Oct 81 |
| Missile Electronics and Computer Assembly | Nov 81 | Dec 82 |
| Reentry System Shroud Fly-Away | Dec 81 | Dec 81 |
| Canister Assembly Launch Test Program | Jan 82 | Dec 85 |
| Modal Survey | Feb 82 | Apr 82 |
| Guidance and Control (G&C) Integration | Mar 82 | Sep 85 |
| Reentry Systems Stiffness | Mar 82 | Mar 82 |
| Vandenberg Air Force Base Pathfinder (Missile/Pad) | Jun 82 | May 83 |
| Reentry System Flight Proof | Jun 82 | Mar 83 |
| Missile Assembly Building/Launcher Handling | Sep 82 | Jun 83 |
| Guidance and Control Environmental (Flight Proof) | Nov 82 | Jan 84 |
| Electromagnetic Pulse/Electromagnetic Interference/Electromagnetic Compatibility | Jan 83 | Jun 84 |
| Electromagnetic Pulse | Apr 83 | Oct 86 |
| Vandenberg Air Force Base Pad Launches (8) | Jun 83 | Jun 85 |
| Reentry System Deployment Module Electronics (DME) Compatibility | Nov 83 | Dec 83 |
| Reentry System Qualification (Without DME) | Nov 83 | Jun 85 |
| Deployment Module Electronics Radiation | Jan 84 | Jun 84 |
| Full-Scale Development Sled | Feb 84 | Jul 86 |
| Mechanical Qualification Tests T6.2-3 | May 84 | May 84 |
| Reentry Vehicle Flight Proof | Jul 84 | Oct 84 |
| Emplacer, Functional | Dec 84 | May 85 |
| Mechanical Fragility Test T13.1 | Dec 84 | Mar 85 |
| LF-05 Mechanical Development Test | Jan 85 | Apr 85 |
| Vandenberg Air Force Base Pathfinder (Missile/Silo) | Feb 85 | May 85 |

Budget Activity: 3. Strategic Programs
Program Element: 64312F, Peacekeeper

| Test | From | To |
|---|---|---|
| Missile Electronics and Computer Assembly Radiation/System-Generated Electromagnetic Pulse Test | Feb 85 | Aug 85 |
| Missile Electronics and Computer Assembly Mechanical Qualification Test | Mar 85 | Aug 85 |
| Common Airborne Launch Control Center (ALCC) Class II Development Flight Tests | Apr 85 | Aug 85 |
| Reentry Vehicle Qualification | Apr 85 | Oct 85 |
| Alternate Source Ordnance Initiation Set | Jun 85 | Mar 86 |
| Vandenberg Air Force Base Silo Launches (12) | Aug 85 | 1st Qtr CY89 |
| Missile Guidance and Control Set Radiation Qualification Test | Oct 85 | Sep 86 |
| Inertial Measurement Unit Limit Radiation Test with Missile Guidance Control Set Test | Oct 85 | Sep 86 |
| Deployment Module Electronics Qualification | Oct 85 | Dec 85 |
| MK 21 Fuze Radiation | Nov 85 | Jun 86 |
| Missile Guidance and Control Mechanical Qualification Test | Nov 85 | Apr 86 |
| Battery Mechanical Qualification | Jan 86 | Jan 86 |
| Inertial Measurement Unit Mechanical Qualification Test | Mar 86 | Dec 86 |
| Missile Electromagnetic Pulse Test (T607) | Apr 86 | Oct 86 |
| Rack Mechanical Fragility Testing T13.4 | Apr 86 | Jul 87 |
| Common Airborne Launch Control Center (ALCC) Electromagnetic Compatibility Margin Test | Jul 86 | Sep 86 |
| LF-05 Electromagnetic Interference/Electromagnetic Compatibility Testing | Jan 87 | Mar 87 |
| Common ALCC Pre-Initial Operational Capability Test | Mar 87 | Jun 87 |

2. (U) Operational Test and Evaluation (OT&E): This is a combined DT&E/OT&E program, with Air Force Operational Test and Evaluation Center (AFOTEC) managing the OT&E portion. OT&E objectives have been fully integrated with DT&E objectives to reduce schedule and cost impacts. An AFOTEC test team has been formed which includes personnel from Strategic Air Command, Air Force Logistics Command, Air Force Communications Command, Air Training Command, and AFOTEC. All test scenarios will be structured to accommodate the objectives of the combined test program and satisfy the five operational critical issues: mission effectiveness, probability of damage, survivability, weapon system integration, and weapon system operation and support. A program of 20 launches with evolution from mainly DT&E- to OT&E-oriented objectives is planned.

Budget Activity: 3. Strategic Programs
Program Element: 64312F, Peacekeeper

(U) Seventeen of the planned 20 Peacekeeper test launches have been completed. The first of four phases of the missile launch program (does the booster work?) ended with the successful launch of the fifth Peacekeeper on 15 June 1984. The second phase of testing (how well does the missile system work?) was completed with the successful thirteenth launch on 23 August 1986. Phase three of the test program (will it work as a weapon system?) finished successfully with the sixteenth launch on 13 February 1987. Flight 17 was successfully launched on 21 March 1987. The last phase of flight testing (operational system verification) will be completed with the final three flights. This phase will further verify operational procedures and any configuration block changes.

(U) Overall, the Peacekeeper test and evaluation is progressing satisfactorily. An interim report was published in September 1987. The weapon system is meeting operational requirements. Interim results indicate it will continue to do so.

3. (U) System Characteristics:

(U) Because the weapon system has many elements that contribute to its effectiveness, and because management tradeoffs between these elements are necessary to identify the most cost effective combination, Peacekeeper In Minuteman Silos program thresholds and goals have been established at the weapon system level.

(U) The two goals and thresholds established for the Peacekeeper In Minuteman Weapon System by the Program Management Directive are the mission effectiveness factor (MEF) and accuracy expressed as circular error probable (CEP).

(U) MEF is defined as the product of launch (countdown) and flight reliability, weapon system availability, and targeting efficiency.

The MEF goal is [ ] and the threshold is [ ] as of December 1987 the MEF is [ ]

(U) Launch (countdown) and flight reliability is defined as the probability that an available missile system will, disregarding the effects of enemy action, respond to a valid launch command and will successfully complete launch and flight resulting in the detonation of a given warhead within 3.5 times the circular error probable requirement. During the DT&E/OT&E program, the operational launch (countdown) and flight reliability will be assessed using flight testing and applicable ground testing such as motor static testing, launch system testing, command, control and communication testing, and guidance and control testing. It is anticipated that failures will occur during the early phase of the flight test program. Causes of the failures will be corrected through a reliability improvement program. Test data will be modified or purged only after sufficient testing has been accomplished to verify the effectiveness of the corrective action. The limited data base available at initial operational capability (IOC) will not support a high level of confidence in the assessed launch (countdown) and flight reliability value. Strategic Air Command follow-on operational test and evaluation results accumulated after IOC will increase confidence in the accuracy of this assessment.

Budget Activity: 3. Strategic Programs
Program Element: 64312F, Peacekeeper

(U) Weapon system availability is defined as the percentage of a missile force, under the jurisdiction of the using command and committed to the wartime mission, which is capable of commitment to the launch sequence at any random point in time. Prior to initial operational capability (IOC), availability predictions will be based upon a probabilistic availability model. Simulations will be used as necessary to verify the availability prediction and to generate inputs to the model for variables such as spares availability that are not conducive to probabilistic solution. Subsequent to IOC, actual field experience as reported by the Strategic Air Command will be the basis for availability assessments.

(U) Targeting efficiency is defined as the ratio of the number of targets in a reference target list to the number of reentry vehicles flown to achieve 100% coverage of that same target list. The targeting efficiency assessment will be continually updated from the missile system engineering studies to track the performance of the Peacekeeper missile during the DT&E/OT&E program. Missile parameters, such as subsystem weights and motor specific impulse, may vary during development and test. If so, this will influence missile performance against various target structures.

(U) Accuracy is a measure of the miss distance for a reentry vehicle that has been delivered to the target area. Accuracy is expressed as circular error probable which is defined as the radius of a circle centered on an aim point within which 50% of the reentry vehicles are expected to be located at impact.

(U) The evaluation of accuracy is a continuing process which begins with the design of the weapon system and continues throughout the life of the flight test program. Initially, error budgets are established at the subsystem level to derive an accuracy budget at the weapon system level. The major subsystems for categorizing accuracy include guidance and control, targeting, geodetics and geophysics, and reentry. Guidance and control includes inertial measurement unit (including gyroscopes and accelerometers), hardware errors, ground program errors, flight program errors and certain elements in the deployment sequence. Reentry subsystem errors include the reentry vehicle, certain elements of separation, and reentry dispersion due to atmospheric conditions. Targeting and geodetic and geophysical evaluations are primarily accomplished by computer simulations.

(U) During the Peacekeeper In Minuteman Silos test program, flight test results will be used to validate the engineering estimates. Confidence in achieving the system accuracy goal will increase during DT&E/OT&E ground and flight testing. A mature system accuracy assessment will be completed approximately 3-5 years after Peacekeeper In Minuteman Weapon System initial operational capability.

The operational accuracy goal for the mature Peacekeeper system is at a north-firing range of Current engineering estimates and flight test data indicate this goal will be achieved.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

(U) The Peacekeeper missile has the following additional characteristics:

(U) The Peacekeeper will weigh 195,000 pounds.

(U) The Peacekeeper will deliver a payload of up to 10 MK-21 reentry vehicles.

The Peacekeeper will have a range of [ ] with an accuracy of [ ]

(U) The system will have a remote fault detection capability to isolate 95 percent of all launch critical faults to a line replacement unit on Peacekeeper unique equipment.

The system will provide [ ]

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| Sixteenth flight | 4th Qtr CY86 | Feb 87 | Demonstrated the capability to launch and deploy RVs over an enlarged footprint including land impact. Alternate power source (diesel generator) was not used due to diesel problems. |
| Seventeenth flight | 1st Qtr CY87 | Mar 87 | Demonstrated the capability to launch using an alternate power source (batteries). |
| Airborne launch control center test | 1st/2nd Qtr CY87 | Mar-May 87 | Demonstrated capability of the new common airborne launch control center to command and control Peacekeeper missiles. |

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
| --- | --- | --- |
| Airborne launch control center test | 1st Qtr CY88 | Demonstrate full capability of the common airborne launch control center to command and control Peacekeeper missiles (including status update and remote retargeting). |
| Eighteenth flight | 3rd Qtr CY88 | Demonstrate capability to deploy penetration aids and launch with Airborne Launch Control System. |
| Nineteenth flight | 4th Qtr CY88 | Demonstrate the capability to launch with the Airborne Launch Control System, to deploy reentry vehicles over an enlarged footprint (including land impact), and to use alternate ground power (batteries and diesel). |
| Twentieth flight | 1st Qtr CY89 | Demonstrate the capability to launch with the Airborne Launch Control System and to deliver reentry vehicles over an extended footprint including land impact. |

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604326F
DOD Mission Area: #113 - Airborne Strike

Title: Strategic Conventional Standoff Capability (SCSC)
Budget Activity: #3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 28,188 | 7969 | 10,000 | 22,031 | 97,301 |
| 3076 | Active Targeting Sensor Development | 3,803 | 0 | 0 | 0 | 18,682 |
| 3160 | Have Dark | 7,194 | 0 | 0 | 0 | 21,428 |
| 3679 | HAVE NAP* | 17,191 | 7969 | 10,000 | 22,031 | 57,191 |

* FY 1988 Project 3679 HAVE NAP funds have been added to Program Element requiring FY 1989 RDT&E Descriptive Summary.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Strategic bombers require the capability to autonomously detect, track, classify, engage and destroy enemy mobile, fixed and maritime targets anywhere in the world while minimizing their exposure to lethal defenses. This program element provides funding for validation demonstration of HAVE NAP technology. Congressional addition of FY 1988 and FY 1989 funding for HAVE NAP will fund IOT&E and develop missile adjustments to meet operational requirements and U.S. safety standards.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY:

EXPLANATION: (U) This is not applicable--there were no RDT&E funds requested in the original FY 1988/1989 budget submission.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| (U) PE 0101113F B-52 Squadrons<br>Project 3679 HAVE NAP<br>Missile Procurement (3020) | | | | | |
| Funds | 0 | 0 | 8,300 | 66,800 | 7[illegible],100 |
| Quantities | - | - | (12) | (74) | (86) |

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Modifications (3010) | | | | | |
| Funds | 0 | 0 | 16,100 | 5,000 | 21,100 |
| Quantities AC/DLP | - | - | (15/6) | (0/4) | (15/10) |

5. (U) RELATED ACTIVITIES: Project 3160 HAVE DARK activities transfer to Program Element 0604738F Protective Systems, project 5615 Strategic Protective Systems. Project 3076, Active Target Sensor Development activities transfer to Program Element 0603367, Relocatable Target Capability Program, Project 3368.

6. (U) WORK PERFORMED BY: The SCSC HAVE NAP program is managed by Air Force Systems Command's Armament Division Air to Surface Guide Munitions Office at Eglin Air Force Base, Florida. RAFAEL and Martin Marietta are under contract for missile modification and production and BMAC under contract for B-52 modification.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3679, HAVE NAP

A. (U) Project Description: The project will initiate the Initial Operational Test and Evaluation (IOT&E) of a medium range standoff precision guided conventional missile. SAC will conduct IOT&E and will test the system's operational capability from a B-52G platform. The missile has a single stage, low smoke rocket motor and carries a 726 lb warhead. It is navigated to the target area by an inertial navigational system and uses an electro-optical seeker for terminal guidance. An IIR seeker is currently in the advanced stages of development and will be evaluated during IOT&E. The missile is currently being produced and is operational in the Israeli Air Force.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: A Foreign Weapons Evaluation (FWE) of the HAVE NAP weapon system launched from a B-52G was completed with two successful tests in two attempts. This portion of FWE was completed on time in July 1987. The HAVE NAP FWE launch from an F-111 has been delayed due to technical interface problems with the aircraft and now the flight is scheduled to be completed by 1QFY 1989. This is approximately a one year slip; however, will have no effect on accomplishing the B-52G Initial Operation Test and Evaluation (IOT&E) scheduled to begin 3QFY 1988.

(2) (U) FY 1988 Program: The HAVE NAP weapon system will begin IOT&E ground testing and training as soon as assets become available. Contract award is estimated for May 1988, followed by delivery of test assets and the Class II modified aircraft in July 1988. Development will begin on the weapon system adjustments to allow HAVE NAP to meet operational requirements and conform to Air Force operational and safety standards. These include adjustments to the rocket motor propellant and liner, changes to the data link frequency and a switch to U.S. approved explosives in the in-line rocket ignition train.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request:

- (U) IOT&E flight test will begin in 1QFY 1989. The test program has planned for a total of eight flights, scheduling one launch per month. This effort will cost approximately $7.0 million. Strategic Air Command (SAC) has estimated it will cost $5.0 to conduct the program, and the contractor has given a rough order magnitude (ROM) of $2.0 million to provide logistic and maintenance support. The remaining $3.0 million will fund developmental costs associated with the Class V modification to the B-52G.

- (U) This program was identified as a new start during the recent FY 1988 budget appropriations. The program office is currently involved preparing a comprehensive estimate of cost elements. However, cost estimates at this point are preliminary (Category IV - Planning Stage). Estimating techniques used planning factors associated with test and evaluation of weapon systems similar to HAVE NAP. Cost factors used ROM estimates from the foreign contractor when available. Because of the urgent need requirement, the program is being pursued under sole source procurement for IOT&E and production.

- (U) Technical efforts are required involving integration of the missile system to the aircraft. The result will be a Class V modified B-52G with a HAVE NAP production kit. The effort will take approximately six months from contract award.

(4) (U) Program to Completion: This program completes all required RDT&E activities in FY 1989. Milestone III production decision is scheduled to occur in June 1988 for low rate missile procurement and aircraft modification.

C. (U) Major Milestones:

(1) (U) IOT&E will be conducted in three phases, initial preparation, ground and captive carry flight testing and operation test launches from a B-52. Production decisions will be made following evaluation of IOT&E.

(2) (U) Major Milestones:

| Milestones | Dates |
|---|---|
| **(U) IOT&E** | |
| Phase I - Initial test preparation (acquire test assets) | 3QFY 1988 |
| Phase II - Ground and captive carry flight tests | 3QFY 1988 |
| Phase III - Test launches | 1QFY 1989 |
| **(U) Production** | |
| Initial contract award (Lot I and Aircraft Mod) | 3QFY 1989 |
| Class V aircraft modification (begin) | 1QFY 1990 |
| Lot I production deliveries | 3QFY 1990 |
| Complete production deliveries | 4QFY 1993 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604361F
DOD Mission Area: 113 - Airborne Strike

Title: Air-Launched Cruise Missile, AGM-86B
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional To Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 4,719 | 3,577 | 957 | 1,352 | 1,158,712 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Launched Cruise Missile (ALCM) greatly enhances the air breathing leg of the Triad by: stressing/diluting Soviet defenses, thus improving the overall penetration prospects of the mixed air breathing force; compelling the Soviets to devote substantial resources to their national air defenses to counter this threat; increasing the number of weapons in our strategic forces in the near term and convincing the Soviets that their massive air defense efforts will not substantially blunt U.S. air breathing strike capabilities.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 4,792 | 3,591 | 958 | 1,352 | 1,158,800 |
| Missile Procurement | 12,053 | 2,347 | 1,186 | 0 | 2,597,500 |

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Missile Procurement | 9,361 | 2,347 | 0 | 0 | 2,593,622 |
| (Missile Quantity) | (0) | (0) | (0) | (0) | (1715) |
| Military Construction | 0 | 0 | 4,800 | 4,965 | 280,400 |

Department of Energy Costs* [ ]
(W-80 Warhead)
* W-80 cost based on [ ] warheads.

5. (U) RELATED ACTIVITIES: The AGM-86B Air-Launched Cruise Missile (ALCM) program is managed by Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH. The ALCM, the land attack Sea-Launched Cruise Missile (SLCM), and the Ground Launched Cruise Missile (GLCM) programs are structured to have maximum commonality in engine and navigation/guidance subsystems. The ALCM and SLCM share the common W-80 nuclear warhead developed by the Department of Energy. The engine and navigation/guidance projects are jointly managed through the Joint Cruise Missiles Project Office. The B-52 Squadrons, PE 0101133F, is also related to the ALCM. The B-52 Cruise Missile Carriage, Offensive Avionics System, and other projects require close coordination with the ALCM program to ensure full compatibility.

6. (U) WORK PERFORMED BY: The major contractors are: Boeing Aerospace, Seattle, WA (air vehicle); Williams International Corporation, Walled Lake, MI; Teledyne CAE, Toledo, OH (engine); Litton Industries, Woodland Hills, CA; Litton of Canada Limited, Toronto, ONT; and Minneapolis Honeywell, Minneapolis, MN (navigation guidance). In-house developing organizations are: Defense Mapping Agency and the Joint Cruise Missiles Project Office.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604361F, Air-Launched Cruise Missile

A. (U) Project Description: The ALCM is a small, long range, accurate, nuclear armed air-to-ground cruise missile. The missile is powered by a small turbofan engine in the 600 pound thrust category. Missile navigation is accomplished by means of an inertial navigation system and a terrain contour matching system. ALCM carriage and launch will be from bomber aircraft. Initially, ALCMs will be carried on B-52G/H aircraft on external pylons and internally on launchers (B-52G external only, B-52H both external/internal). The B-1B aircraft will also be cruise missile capable for use in the 1990s and beyond.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 program provided the Strategic Air Command with an Operational Test Launch (OTL) mission planning capability and an improved mission planning computer program which established the mission terrain following altitude setting. Also, during FY 1987, the integrated ALCM/Short Range Attack Missile (SRAM) OTL payload checkout test set was developed.

(2) (U) FY 1988 Program: The FY 1988 program completes development of the ALCM/SRAM OTL test set, revises mission planning software (Navigation Accuracy Module), revises missile software for a new radar altimeter, initiates the final phase of B-1B integration tests for B-1B flight testing and makes Electronics System Test Set (ESTS) compatibility changes. Cost estimates are based on firm contractor prices for this mature production program.

Program Element: 0604361F — Title: Air Launched Cruise Missile, AGM-86B
DOD Mission Area: 113 - Airborne Strike — Budget Activity: 3 - Strategic Programs

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program completes the ALCM/B-1B R&D acoustic integration testing, mission planning improvements and missile software changes.

(4) (U) Program to Completion: The ALCM program will be completed in FY 1990 with accomplishment of required modification and other residual tasks.

C. (U) Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| (1) | (U) | Defense Systems Acquisition Review Council I (Prog. Initiation) | February 1974 |
| (2) | (U) | Defense Systems Acquisition Review Council IA (AGM-86A) | March 1975 |
| (3) | (U) | First Powered Flight (AGM-86A) | March 1976 |
| (4) | (U) | Defense Systems Acquisition Review Council II (AGM-86A/B) | January 1977 |
| (5) | (U) | AGM-86B/AGM-109 Competition Directed | July 1977 |
| (6) | (U) | First Full-Scale Engineering Flight | July 1979 |
| (7) | (U) | Source Selection | March 1980 |
| (8) | (U) | Defense Systems Acquisition Review Council III (Production Decision) | April 1980 |
| (9) | (U) | First Alert Capability (One B-52G) | September 1981 |
| (10) | (U) | Initial Operational Capability (First B-52G Squadron) | December 1982 |
| (11) | (U) | Full Operational Capability (AGM-86B) | Fiscal Year 1989 |

8. COOPERATIVE AGREEMENTS: Canada - This Technical Arrangement, signed 14 Feb 84, concerns authorization of overflights of the AGM-86B Air-Launched Cruise Missile (ALCM) over Canadian territory. The agreement comprises the ground-rules for U.S. Test and Evaluation of the ALCM over Canada and limits the flight tests to a maximum of 6 launches in any one 12 month period. Also, all launch dates must be scheduled in the first quarter of the calendar year. To date, [ ] U.S. Forces retain custody/control over all U.S. weapons and are assisted in conducting surveillance and security by the Canadians. Cumulative cost for this support is $300 thousand dollars (Canadian).

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604406F
DOD Mission Area: 123 - Space Defense

Title: Space Defense Systems
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 169,211 | 131,852 | 0 | 0 | 1,562,100 |
| 2134 | Miniature Systems | 169,211 | 131,852 | 0 | 0 | |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program was developing and testing an antisatellite (ASAT) system in response to guidance contained in National Space Policy and the Secretary of Defense approved Mission Element Need Statement. This system is to deter Soviet ASAT attacks on critical US space systems, as well as to negate those Soviet space systems which would be used to target U.S. terrestrial forces, denying the Soviet's enhancement of their ability to destroy U.S. forces. The air-launched miniature vehicle (ALMV) ASAT developed consists of a modified Short Range Attack Missile (SRAM) first stage, an ALTAIR second stage, and a Miniature Vehicle warhead. ASAT missiles will be launched from designated, dual mission, air defense F-15s. To support ASAT testing, a dedicated target satellite (Instrumented Test Vehicle) was developed. Altitude enhancements to the MV ASAT and development of ground-based laser (GBL) technology as an ASAT system were funded in this project.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 189,285 | 402,358 | 385,812 | Continuing | N/A |
| Aircraft Procurement | 0 | 0 | 33,900 | 110,695 | 186,895 |
| Missile Procurement | 0 | 21,800 | 364,539 | Continuing | N/A |
| Other Procurement | 0 | 8,540 | 0 | 0 | 8,540 |

EXPLANATION: (U) In FY 1988, Congress reduced our funding to 135,000 and deleted all procurement funding. Project 3647, Ground Based Laser Technology, (FY 1988 - $46,650) was transferred to PE 0603605F, Advanced Radiation Technology, by congressional direction in the FY 1988 Appropriations Bill. Congress also reimposed the moratorium prohibiting testing against objects in space and restricted the implementation of the Production Verification (PV) effort. Due to these actions, the air-launched ASAT development was terminated.

Program Element: 0604406F
DOD Mission Area: 123 - Space Defense

Title: Space Defense Systems
Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) None.

5. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: As explained above due to the lack of sufficient funding to conduct a prudent development and test program and the continuing congressional restrictions on testing, further development has been terminated on the air-launched miniature vehicle ASAT program.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604711F
DOD Mission Area: 113 - Airborne Strike

Title: Systems Survivability (Nuclear Effects)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 12,793 | 12,926 | 8,333 | Continuing | N/A |
| 2485 | S/V Assessment of Ground C3 Systems | 1,338 | 0 | 0 | | N/A |
| 3429 | B-1B EMP Test | 4,500 | 8,076 | 5,340 | 2,700 | 20,616 |
| 3763 | S/V Assessment of Aerospace Systems | 6,955 | 4,850 | 2,993 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Develops and demonstrates the engineering capability required for high confidence verification, hardening, and maintenance of Air Force and DOD aerospace, aircraft, and missile systems which must operate and survive in a nuclear environment. Funds the Electromagnetic Pulse (EMP) Design Verification Test of the B-1B. Determines through analysis and testing the survivability/vulnerability (S/V) of Air Force and DOD aerospace systems to nuclear effects. Establishes EMP standards and specifications for Air Force and DOD programs. Areas this program supports are: strategic bombers, tactical fighters, airlift, and missiles. The nature of threat to Air Force systems requires that they be able to operate in a variety of nuclear environments. To insure system survivability in these environments, the Air Force needs hardening materials, analytical techniques, and test methods to develop reliable, cost-effective hardening techniques and to verify/assess system hardness.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY ($ in thousands):

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 13,061 | 12,976 | 11,340 | Continuing | N/A |

EXPLANATION: (U) Due to reduction of $3.0 million in Project 3763 in FY 1989, efforts to develop blast and shock S/V engineering capability and support of the Defense EMP Standards and Specifications Program are terminated.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) **RELATED ACTIVITIES:** This program is related to Air Force programs which develop and maintain a survivable strategic force with associated command and control communications systems. Related programs are: PE 0604747F/Project 1209, Nuclear Effects Simulation Test Facilities; PE 0603605/Project 3277, Aeronautical and Missile System Survivability; PE 0603605/Project 3278, Ground-based System Survivability; PE 0602601F/Project 8809, Nuclear S/V Technology; PE 0701111F, Aircraft and C3I S/V Maintenance. Test facilities for this program are acquired under PE 0604747F/Project 1209. A joint working group between the Air Force, the Defense Communications Agency, and the Defense Nuclear Agency (DNA) has been established to coordinate command, control, and communications assessment plans and to effect timely exchange of results. The Under Secretary of Defense for Acquisition has established a joint DNA/Multi-Agency Cooperative Electromagnetic Pulse (EMP) Hardening Technology Program to coordinate the efforts of DNA and the services in developing EMP hardening technology, and has established a Defense EMP Standards and Specifications Program for fixed-wing aircraft and ground based communications systems.

6. (U) **WORK PERFORMED BY:** The program is managed by the Air Force Weapons Laboratory, Kirtland AFB, NM, except for the B-1B EMP test managed by Aeronautical Systems Division B-1B System Program Office. The top five contractors are: North American Aviation Operation, Rockwell International, Los Angeles, CA (Project 3429); Boeing Military Aircraft Company, Seattle, WA (Project 3429); Aircraft Engine Group, General Electric Corporation, Evandale, OH (Project 3429); UNM NMERI, Albuquerque, NM (Project 3763); United Engineering, Inc, Albuquerque, NM (Project 3763). A total of six additional contractors hold contracts worth approximately $50,000,000.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:**

A. (U) Project: 3429, B-1B EMP Test. This project funds the EMP Design Verification Test (DVT) of the B-1B. Objectives of the test are: verify EMP design specifications, design implementation and safety margins; establish an hardness maintenance/hardness surveillance (HM/HS) baseline for the B-1B maintenance concept; and provide data to evaluate EMP hardening designs for future aircraft. In FY 1987, detailed test planning and preparations for the Phase I test were completed and detailed planning for the Phase II test began. Early in FY 1988, Phase I of the EMP DVT will be accomplished on a B-1B aircraft at the Air Force Weapons Laboratory at Kirtland Air Force Base, New Mexico (KAFB,NM). This survey testing will provide data for test instrumentation development and for test point selection to support the primary Phase II test later in 1988. In 1988, the planning and preparation for the Phase II test will be completed, and the test will start on a B-1B production model at KAFB,NM. The Phase II test will be conducted at the Air Force high level EMP simulators, including the TRESTLE. This test will verify EMP design integrity and correlate high level test data with low-level test data to support the HM/HS baseline establishment. In FY 1989, the Phase II test will be completed, test data will be analysed, and the results will be compared to the test objectives. Planning for the Phase III retest in 1990 will begin. The Phase III retest will examine the EMP protection features at selected points on the same aircraft used during the Phase II testing. The retest will measure degradation, if any, of selected EMP protection features after aircraft operation and maintenance over two years. The Phase III test data will support the hardness maintenance baseline for the B-1B fleet. The estimated costs are based on past program experience, adjusted for expected cost growth, and projected man-hours to perform the above tests in a competitive environment. The cost estimates are considered Category III, Budgetary, since fixed price contracts have been negotiated.

B. (U) Project: 3763, S/V Assessment of Aerospace Systems. This project develops and validates advanced nuclear hardening techniques and nuclear hardness maintenance/hardness surveillance (HM/HS) techniques for aircraft and missile systems. The nuclear survivability/vulnerability (S/V) of selected systems is determined by analysis and testing. The engineering techniques developed under this project are transferred to Air Force Product Divisions and Operating Commands for application to new aerospace systems under development or existing systems in operation. During FY 1987, test procedures and test equipment to support aircraft subsystem HM/HS were developed and demonstrated on the electromagnetic pulse test bed aircraft (EMPTAC). The EMPTAC is a Boeing 720 aircraft modified by adding hardening features similar to those found on strategic aircraft such as the B-52, E-4, and B-1B. Techniques were developed to test the electrical integrity of electrical cable shields and door and window electrical gaskets. Continuous wave (CW) test equipment to survey the EMP hardening features of large aircraft was developed and demonstrated on the EMPTAC. Experiments were performed with both the CW tester and the TRESTLE, using the EMPTAC, to develop a correlation between low level CW data and high level TRESTLE pulse data. Establishing this correlation will allow the data from this low cost, portable CW test equipment to be used to assess the survivability of aircraft to the high level nuclear EMP pulse. In FY 1988, subsystem test equipment will be prototyped and demonstrated on a B-1B aircraft. The cable shield tester will be applied to provide quality checks on the Common Strategic Rotary Launcher production line. The continuous wave (CW) tester will be demonstrated on the B-1B aircraft, and the test equipment and procedures will be transferred to Oklahoma City Air Logistics Center (OC-ALC). Efforts will continue to correlate CW and high level pulse test data using the B-1B and electromagnetic pulse test bed aircraft (EMPTAC). Electromagnetic pulse (EMP) upset testing of an Air Force inertial navigation system will start. Data from this effort will be used to develop upset tolerant design techniques and military specifications and standards. High level pulse test data accumulated over the years will be used to start development of standard EMP design verification methods for aircraft. Development of a hand-held cable shield tester to supplement larger test equipment will start. In FY 1989, development of the hand-held cable shield tester will be completed and the technology transferred to Oklahoma City Air Logistics Center. Efforts to develop methods to diagnose unseen faults in aircraft EMP protection features for use by maintenance depots will start. The objective here is to determine the location and nature of EMP leaks in aircraft by taking a bare minimum of test data. The requirements to support nuclear survivability issues are continuing. New aircraft designs and design technologies force new solutions to the nuclear hardening problem.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0101142
DOD Mission Area: 113 - Airborne Strike

Title: KC-135 Squadrons
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 421 | 4,019 | 3,176 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Improved Aerial Refueling System (IARS) program is designed to fund several research and development projects that will improve the aerial refueling system and thereby enhance the capability of the 1950 designed KC-135 fleet. The requirement for this program was established by the Strategic Air Command in their Required Operational Capability 1-77 (validated September 1980) which identified deficiencies in fuel pressure regulation, fuel offload rates, disconnect capability, boom control authority, probe and drogue refueling equipment, and boom operator's station equipment. The IARS program is phased over the years to investigate system changes to alleviate deficiencies, improve the overall refueling capability of the aircraft and enhance inter- and intra- service and NATO aerial refueling procedures.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 3,708 | 4,035 | 4,179 | Continuing | N/A |

(U) EXPLANATION: The FY 87 reduction is a result of a Congressional funding reduction and an Air Force reprogramming action. As a result of this, work on the improved boom nozzle and the redundant light system was delayed seven months. The FY 88 figure reflects an adjustment for revised inflation indices. The FY 89 figure reflects an OSD reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable

5. (U) RELATED ACTIVITIES: Not applicable

6. (U) WORK PERFORMED BY: The primary contractors: J.C. Carter Co., Costa Mesa, CA; Sargent Fletcher Co., El Monte, CA; XAR Industries, City of Industries, CA; and Dataproducts New England, Inc., Wallingford, CN. The in-house developing organizations: Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH; 4950th Test Wing, Wright-Patterson AFB, OH; and 6150th Test Wing, Edwards AFB, CA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2214, Improved Aerial Refueling Systems (IARS)

A. (U) Project Description: The purpose of the IARS program is to investigate a number of projects which are designed to improve the aerial refueling capability of the KC-135 aircraft. IARS projects improve night aerial refueling capability by improving the boom nozzle light and correct deficiencies in fuel pressure regulation, fuel offload rates, disconnect capability, boom control authority, probe and drogue refueling equipment and boom operator station equipment. The air refueling nozzle program incorporates disconnect capability independent of receiver aircraft systems and sensors to alleviate stress loading on the boom during aerial refueling contact. The project also pursues improvements to the aerial refueling boom to provide increased boom control authority for an expanded air refueling "envelope" (area in which the receiver can maneuver while hooked up to the boom). These efforts will help eliminate brute force disconnects and nozzle/receptacle binding, reduce receiver pilot fatigue, and enhance safety by expanding the limits of the envelope. Additionally, work is being done to compile aerial refueling data from all DOD aerial refueling users and contractors. This consolidated information will be published in a performance interface document that will enhance aerial refueling procedures. The IARS program is vital to improve the 1950's technology of the KC-135's aerial refueling system and to make sure the aircraft is capable of continuing to meet its worldwide refueling requirements.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Aeronautical Systems Division continued the development/design of the improved boom nozzle light system. This system will upgrade the present boom nozzle light and install a second light to increase illumination and add redundancy. Service test data was collected. Work on the KC-135 Performance Interface Document was initiated. Surveys and questionnaires were returned and the data was analyzed. This document is designed to consolidate aerial refueling information for both tankers and receivers. Design and development of the coupling insert was completed. This insert serves as a spacer ring inside the aerial refueling basket and allows for different size drogue refuelings. Production will begin in FY 88.

(2) (U) FY 1988 Program: There are several projects being worked in FY 88. First is the KC-135 Performance Interface Document. Work is continuing on cataloging tanker and receiver capability data. When finished, this document will list all pertinent refueling information on the KC-135 and describe refueling characteristics for almost all US and NATO receivers. The first draft should be completed by the end of FY 88. Development and testing of the improved boom nozzle lighting system should be completed in FY 88. Finally, work on an improved KC-135 boom nozzle will begin. Using contractor supplied prototypes, it is planned that each nozzle will be installed on five KC-135s for a service test and evaluation. Following data collection and evaluation, a final nozzle recommendation will be made.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Finalize the improved nozzle and boom assembly design and begin construction of a prototype. This equipment will be tested by the government. Laboratory testing, at a cost of over $100,000 will be followed by aircraft ground tests on a modified Air Force Systems Command KC-135. The Class II modification, based on similar work in 1982-83, and tests are estimated to cost approximately $500,000. The remaining money is required to continue initiation of design/development of an air refueling boom with improved boom control authority. The FY 1988 program will work on developing an improved aerial refueling boom which incorporates an independent nozzle disconnect system, improved boom nozzle lighting (including redundant systems with

variable intensity) and improved boom control in pitch and azimuth (including trim to relieve operator fatigue). This will include a tanker-initiated independent aerial refueling nozzle disconnect capability to release the boom nozzle from the receiver aerial refueling system (receptacle). The improved nozzle flight testing, test report, and demodifica on will be completed. A design study will begin for a suitable location on the KC-135 wing for the pod-mounted hose/reel probe and drogue system. The pod system permits the KC-135 to refuel with either a probe and drogue or a boom system. Additionally, initial design for the installation of a new KC-135 aerial refueling receptacle will also begin.

(4) (U) Program to Completion: The ARS program is a continuing effort of individual projects that will not only improve the KC-135's air refueling system, but also advance technology for future applications in this mission area. Future years' efforts include: design and installation of a prototype air refueling receptacle for the KC-135, testing of boom operator station improvements, development of pod-mounted hose/reel probe and drogue system, and development of a boom-configured multi-point aerial refueling system.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Improved Boom nozzle lighting<br>IOC | 3rd Quarter FY 1988 |
| (2) (U) Improved nozzle<br>IOC | 2nd Quarter FY 1989 |
| (3) (U) Multi-point hose reel<br>IOC | 4th Quarter FY 1989 |
| (4) (U) Improved boom<br>IOC | 2nd Quarter FY 1990 |
| (5) (U) Boom operator station improvements<br>IOC | 3rd Quarter FY 1990 |

(U) Explanation of Milestone Changes: Milestones slipped as a result of a reprioritization of requirements by SAC and program funding cuts. IOC dates are included because procurement schedules are not firm.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): DT&E for the KC-135 was combined with part of the operational test and evaluation (OT&E) program. Combined DT&E/OT&E was conducted at Wichita, Kansas, and Edwards AFB, California, from 4 August 1982 to 5 April 1984. The test aircraft flew 77 DT&E/OT&E sorties at Edwards and was evaluated for two months in the climatic laboratory at Eglin AFB, Florida. All elements of the more than 25 updated systems were evaluated with the exception of production engine struts and nacelles, which were installed before the aircraft was delivered to Strategic Air Command on 29 June 1984. Lack of production struts and nacelles had no impact on the DT&E/OT&E program.

(U) No major discrepancies were found during DT&E/OT&E. Because the quick start/auxiliary power unit system (QSAS) was the last system installed, limited time was available for testing. There was insufficient time in the planned test program to incorporate and retest changes mandated by QSAS service reports, so the QSAS was rated undetermined in the final DT&E/OT&E test report. Major areas of concern with the QSAS were slower start times at temperatures above 90F and with strong, gusting, left quartering tailwinds. Those areas were tested by Strategic Air Command during follow-on test and evaluation (FOT&E).

(U) The test team rated the KC-135R's performance, handling, and aerial refueling excellent, reflecting significant improvements over the KC-135A. Mission capability was enhanced by the new and modified systems. Availability, reliability were rated satisfactory, with the engine showing the most improvement. Engine logistics reliability for the KC-135R was three times better than the KC-135A; engine system maintainability showed a fivefold improvement.

| Availability | KC-135A | KC-135R |
|---|---|---|
| Full Mission Capable | 89.1% | 89.1% |
| Mission Capable Rate | 90.8% | 95.0% |
| **Reliability** | | |
| Mission Effectiveness | 95.8% | 98.0% |
| Mean time between maintenance (inherent) | 1.2 hours | 2.2 hours |
| Mean time between maintenance (corrective) | 0.7 hours | 0.7 hours |
| **Maintainability** | | |
| Man-hours per flight hour | 5.9 hours | 3.1 hours |
| Mean man-hours to repair | 3.9 hours | 4.1 hours |

Budget Activity: 3, Strategic Programs
Program Element: 0101142F, KC-135R Modernization Program

2. (U) Operational Test and Evaluation Data: The Strategic Air Command continues to conduct Follow-on Operational Test and Evaluation (FOT&E) of the re-engined KC-135, designated the KC-135R. A final report on KC-135R FOT&E (I) was published in Oct 85, titled, Strategic Air Command (SAC) Project 1415 KC-135R Follow-on Operational Test and Evaluation Final Report Revision 1, encompassing the test period 1 Jul 84 to 30 June 85. The report rated the KC-135R weapon system satisfactory with marked improvement in many operational capabilities over the KC-135A. Improvement in base escape time and increased engine performance and efficiency were the most notable areas. However, several areas were listed as "undetermined" or rated "deficient" at the end of the FOT&E period. These areas were:

(U) The capability of the KC-135R to operate normally in a cold weather environment was rated deficient. During cold weather evaluation, fuel/oil heat exchanger and fuel servo heater units developed leaks at -10 degrees F. An enhanced seal was manufactured and retrofitted. Further testing of this seal was recommended in the final report.

(U) The reliability and maintainability of the Quick Start/Auxiliary Power Unit System (QSAS) and Environmental Control System (ECS) were labeled undetermined. This was due to the low baseline rates reflecting that logistics support was lagging behind aircraft deliveries.

(U) Due to these factors, SAC directed an additional test period from 1 Jan 86 to 30 Jun 86 to further evaluate these areas. The reliability and maintainability of the QSAS and ECS was reported in Jul 86 with considerable improvement in all areas indicated. The cold weather test was scheduled for 27 Jan 86 to 2 Feb 86, however, unseasonably warm temperatures at the test location resulted in postponement of the test. Because of the unpredictability of the weather, the McKinly Climatic Hangar was sought in order to complete the cold weather test in a timely manner. To meet the Climatic Hangar test schedule, SAC extended the test period to 1 Jan 87. Cold weather testing was conducted at McKinley Climatic Lab from 5 Oct 86 to 10 Nov 86.

(U) The KC-135R Cold Weather Test final report was received from the Air Force Flight Test Center (AFFTC) in Feb 87. The results of the test as stated in the report were: "in general, cold weather starting of the KC-135R was satisfactory. Enhancements to the systems since the Climatic Laboratory evaluation in 1984 eliminated the majority of discrepancies previously encountered."

(U) Specifically, the new seals on the fuel servo heater, fuel/oil heat exchanger, and the metal chip detector were satisfactory during the entire test. In addition, the low-energy ignition system, P-10 main engine fuel control, modified prototype Bendix starter control valve, hydraulic reservoir pressurization, hydraulic reservoir surge tank, modified Auxiliary Power Unit (APU) starter turbine, APU door hardware, modified APU drain system and Turbine Engine Monitor System (TEMS) all performed satisfactorily.

(U) However, several minor problems still remain: inadequate hydraulic systems warmup provisions (inadequate procedures and insufficient capacity of the auxiliary hydraulic pumps); inadequate APU fire bottle pressure table in maintenance T.O.; inability of immediate engine start unless the APUs were preheated; increased engine start times using JP-8 fuel; and unsatisfactory multi-purpose engine trailer; and nonworking Power Management Control (PMC) tester. The majority of these deficient items require T.O. changes and are addressed as such in the final report in the form of AF Form 847 changes and Material Deficiency Reports.

Budget Activity: 3, Strategic Programs
Program Element: 0101142F, KC-135R Modernization Program

(U) NOTE: Mean man-hours to repair for the KC-135R were driven by time required to repair cracks in airframe panels and engine struts early in the test program and by adjustments to the high speed trim modification to the autopilot. The cracks were peculiar to the KC-135A airframe used for the KC-135R test bed. The autopilot modification was subsequently deleted from production aircraft.

(U) The KC-135R Program Office, Aeronautical Systems Division, Air Force Systems Command (AFSC), Wright-Patterson AFB, Ohio, was the program manager. Boeing Military Airplane Company, Wichita, Kansas, was prime development contractor. AFSC was responsible for DT&E. The combined DT&E/OT&E team was made up of representatives from the Air Force Flight Test Center, Air Force Operational Test and Evaluation Center, Strategic Air Command (SAC), Air Force Logistics Command, and Air Training Command.

3. (U) System Characteristics:

| CHARACTERISTIC | OBJECTIVE/THRESHOLD | DEMONSTRATED |
|---|---|---|
| Maximum takeoff gross weight | 322,500 lbs | 322,500 lbs |
| Fuel capacity | 203,000 lbs | 203,288 lbs |
| Takeoff ground roll (90F, sea level, air conditioning on) | 9,000 ft | 8,100 ft |
| Critical field length (90F, sea level, air conditioning on) | 11,000 ft | 10,400 ft |
| Fuel savings | 25% | 27% |
| Engine noise | 106 decibels | 97 decibels |

Budget Activity: 3, Strategic Programs
Program Element: 0101142F, KC-135R Modernization Program

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| Cold Weather Test Final Report | 10 Jan 87 | 27 Feb 87 | Final Report Published |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| None | | |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0101213F
DOD Mission Area: 1'1 - Land-Based Strike

Title: Minuteman Squadrons
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT* | 52,439 | 84,295 | 61,069 | Continuing | N/A |
| 133B | Minuteman Squadrons | 12,970 | 10,312 | 61,069 | Continuing | N/A |
| 3626 | Minuteman III Pen Aids | 39,469 | 73,983 | 0 | 0 | 117,510 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Minuteman weapon system became operational in the 1960s and now consists of 450 Minuteman II and 500 Minuteman III (50 of the original 550 were displaced by Peacekeeper) intercontinental ballistic missiles (ICBMs) deployed in hardened underground silos. Minuteman has served as a prime nuclear deterrent force for the United States for 25 years and is projected to maintain this role into the next century. This program element provides improvements and modifications to the Minuteman force to enhance its contribution to strategic deterrence.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 48,333 | 107,672 | 199,615 | Continuing | N/A |
| Missile Procurement | 0 | 0 | 0 | 687,110 | 687,110 |
| Other Procurement | 0 | 0 | 0 | 3,330 | 3,330 |

EXPLANATION: (U)

(U) RDT&E: Increase in RDT&E funding in FY 1987 adjusted for unfunded requirements in the Minuteman III Penetration Aid Upgrade Program (+$5.490 million) and reprogramming actions (-$1.384 million). Decrease in RDT&E in FY 1988 reflects Congressional action to reduce the ICBM Integrated Electronics Upgrade Program because of budgetary constraints (-$10.8 million) and deletion of funding for Semiconductor Piece Parts that should have been in the Operation and Maintenance account (-$9.2 million). FY 1988 reductions also included reprogramming for End Strength Cap (-$1.498 million), Basic Technology Initiative (-$329 thousand) and Project Air Force (-$1.55 million). RDT&E reduction in FY 1989 was caused by termination of the Minuteman III Penetration Aids Program (-$128.782 million) and transfer of $9.707 million for Semiconductor Piece Parts to the Operations and Maintenance account.

Program Element: 0101213F — Title: Minuteman Squadrons
DOD Mission Area: 111 - Land-Based Strike — Budget Activity: 3 - Strategic Programs

**(U) Missile Procurement:** The Total Estimated Cost for Missile Procurement was also reduced by the termination of the Minuteman III Penetration Aids Program (-$271.01 million) and a restructure of the ICBM Integrated Electronics Program (-$50 million).

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement: (ICBM Integrated Electronics) | | | | | |
| Funds | 0 | 0 | 0 | 366,100 | 366,100 |
| Quantities | 0 | 0 | 0 | 135 | 135 |
| Other Procurement: (Portable Security System) | | | | | |
| Funds | 0 | 0 | 0 | 3,330 | 3,330 |
| Quantities | 0 | 0 | 0 | 140 | 140 |
| Operation and Maintenance | | | | | |
| Funds | 0 | 0 | 0 | 20,000 | 20,000 |

5. (U) RELATED ACTIVITIES: Advanced Strategic Missile Systems (ASMS), PE 0603311F, is a program which develops ballistic missile technology for operational and future intercontinental ballistic missile (ICBM) applications. Specific components of the Minuteman III Penetration Aids program were in advanced development in ASMS through FY 1986. ICBM Modernization, PE 0604312F, is developing systems for the next generation missiles. Duplication of effort is avoided by assigning both of these programs and Minuteman development activities to a single organization, the Ballistic Missile Office. The Ballistic Missile Office coordinates activities with Air Force Logistics Command's Ogden Air Logistics Center, the organization with program management responsibility for Minuteman.

6. (U) WORK PERFORMED BY: The primary contractors are TRW, Redondo Beach, CA (Program Support-systems engineering/technical assistance (133B, 3626)); Tracor, Austin, TX (penetration aids chaff development (3626)); Acurex, Mountain View, CA (penetration aids passive decoy development (3626), concept development studies for ICBM Integrated Electronics (133B)); General Electric, Philadelphia, PA (flight test reentry vehicle integration (3626), concept development studies for ICBM Integrated Electronics (133B)); and Rockwell International, Anaheim, CA (accuracy incentives). The responsible Air Force agency is Air Force Systems Command's Ballistic Missile Office, Norton Air Force Base, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 133B, Minuteman Squadrons

A. (U) Project Description: The project supports research and development activities required to keep Minuteman a viable strategic deterrent force. Specific programs supported include ICBM Integrated Electronics and the Minuteman Portable Security System. Program Support includes the Minuteman Long Range Plan effort which incorporates the efforts of the Ballistic Missile Office, SAC and AFLC to identify those areas that will require upgrade, replacement or refurbishment in the future. As a continuing effort, Program Support also includes funding for systems engineering/technical assistance and all operating costs (collateral testing, analyses, travel, etc.) in support of Minuteman programs at the Ballistic Missile Office. Continuing technical expertise for planning, analysis, design, test, and associate systems engineering support is necessary to develop and prove prototypes of improvements to the operational system in accordance with approved program direction.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The program resolved problems encountered during the final assembly and checkout of Command, Control, Communications ($C^3$) Integration Phase II equipment. Development began for a portable security system that will reduce security police manpower requirements by decreasing the number of security guards required on Minuteman launch facilities that have malfunctioning security systems. System studies were conducted for the Intercontinental Ballistic Missile (ICBM) Integrated Electronics program. This program will integrate communications and weapon system control electronics in the Launch Control Center (LCC) and provide new hardware and software to allow automated processing of emergency action messages in the LCC and rapid retargeting of Minuteman missiles to counter strategic relocatable targets. The new system will optimize crew capability to operate in Emergency War Order environments. The Minuteman Long Range Plan effort published a twenty-year technical plan in March, outlining efforts that must be conducted in the future to maintain the operational capability of Minuteman.

(2) (U) FY 1988 Program : Systems Requirement Analyses for the ICBM Integrated Electronics program will begin. Development continues for the Portable Security System program. The category IV cost estimate, reviewed in April 1986, was arrived at through the use of program office assessments utilizing past acquisition history of similar efforts, Technical Analysis and Cost Estimate studies, and data obtained from program office support functions.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program provides initial hardware and software development for LCC integration, rapid message processing and rapid retargeting of ICBMs. The FY 1989 program will award the full-scale development contract and begin hardware and software designs leading to the Systems Design Review. Portable Security System development ends in FY 1989. The Minuteman Long Range Plan will produce another twenty-year technical plan as the output of studies and testing of Minuteman subsystems. The category IV cost estimate, reviewed in April 1986, was also arrived at through the use of program office assessments utilizing past acquisition history of similar efforts, Technical Analysis and Cost Estimate studies, and data obtained from program office support functions.

(4) (U) Program to Completion: Development of the ICBM Integrated Electronics program hardware and software will continue through 1991. Program Support and the Minuteman Long Range Plan effort are continuing programs.

C. (U) Major Milestones:

| | | | Dates |
|---|---|---|---|
| (1) | (U) | ICBM Integrated Electronics Concept Studies Begin | October 1986 |
| (2) | (U) | Minuteman Twenty-Year Technology Plan published | March 1987 |
| (3) | (U) | Command, Control and Communications Integration Phase II Full Operational Capability (FOC) | October 1987 |
| (4) | (U) | ICBM Integrated Electronics Development Begins | October 1988 |
| (5) | (U) | Minuteman Twenty-Year Technology Plan published | March 1989 |
| (6) | (U) | Minuteman Portable Security System First Production | FY 1990 |
| (7) | (U) | ICBM Integrated Electronics Kit Installation Begins | *(FY 1991) FY 1993 |
| (8) | (U) | ICBM Integrated Electronics Installation Complete | *(FY 1995) FY 1994 |

*Date presented in FY 1988/FY 1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(7) (U) ICBM Integrated Electronics Installation slipped because of program funds restructure.
(8) (U) ICBM Integrated Electronics Installation earlier because of program funds restructure.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0101312F
DOD Mission Area: 331 - Strategic Command and Control

Title: Post Attack Command and Control System (PACCS
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 13,715 | 939 | 1,210 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: To provide a survivable command and control facility for the Single Integrated Operation Plan Commanders in Chief (CINCs) that will support the National Command Authority during all phases of a general war. Supports activities currently underway involving all the aircraft of the Worldwide Airborne Command Post System (WWABNCP), including Commander-in-Chief Strategic Air Command; United States Commander-in-Chief European Command; United States Commander-in-Chief Atlantic Command; and United States Commander-in-Chief Pacific Command.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 9,015 | 943 | 1,203 | Continuing | N/A |

EXPLANATION: (U) Funding change in FY 1987 reflects reprogramming of funds to support classified programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: The following Program Elements support the WWABNCP: Strategic Air Command Communications, PE 0101316F; Air Force Satellite Communications Program, PE 0303601F; System Survivability, PE 0604711F; Electromagnetic Radiation Test Facilities, PE 0604747F; National Emergency Airborne Command Post, PE 0302015F; Air Force Support to Minimum Essential Emergency Communications Network, PE 0303131F; Milstar, PE 0303603F; Peacekeeper, Minuteman Common Airborne Launch Control Center, PE 0101215F; and Nuclear Detonation Detection System, PE 0102433F.

6. (U) WORK PERFORMED BY: The WWABNCP System Program Office has responsibility for the program. This is an Air Force Logistics Command organization located at Tinker AFB, OK.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 11312F, Post Attack Command and Control System

A. (U) Project Description: The Worldwide Airborne Command Post (WWABNCP) System Program Office conducts, on a continuing basis, an Electromagnetic Pulse (EMP) Engineering Surveillance program relative to the EC-135 aircraft. This effort establishes and analyzes EMP design specifications for new systems, supports limited subsystem and component testing, investigates new installation techniques to achieve improved EMP protection and provides a continuing analysis of the EMP survivability of the EC-135, a critical airborne Command and Control resource. This is a continuing level-of-effort program.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 effort initiated the Concept Exploration phase for the development of a command, control, and communications suite for an advanced airborne command post. Additional studies were conducted to determine candidate aircraft requirements and costs. These efforts were for WWABNCP System Replacement that were to be accomplished under a new PE (64216F) for FY 1988 and subsequent efforts. The FY 1987 effort continued the EMP Surveillance program on modifications scheduled for installation on the EC-135. These included the Ultra High Frequency Line-of-Sight (UHF/LOS) communication system, Peacekeeper/Minuteman Common Airborne Launch Control System, and the Ground Wave Emergency Network. These efforts ensure the hardness maintenance and surveillance program is compatible with the EC-135 hardness maintenance plan.

(2) (U) FY 1988 Program: The FY 1988 effort continues the EMP surveillance program for the EC-135 to insure the survival of these critical assets against nuclear effects. In FY 1988 planning will start for an aircraft and command and control ($C^2$) suite system EMP test at Kirtland Air Force Base in early FY 1989. This will be the first system test of the hardness levels achieved by the new Ultra High Frequency line-of-sight radio system installed under the PACER LINK Phase II modification. Additional engineering reviews and studies of hardness levels of projected $C^2$ improvements will continue.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 effort center on performing a system EMP test of a PACER LINK modified EC-135 airborne command post, and the analysis of those test results. The EMP surveillance program will continue for projected EC-135 $C^2$ modifications to insure these critical new systems are survivable against nuclear effects. It is crucial that these new systems meet established EMP requirement to insure overall WWABNCP system survivability. Cost estimates are based on previous levels of effort for this program. Cost category is I, Comprehensive.

(4) (U) Program to Completion: This is a continuing program. The Electromagnetic Pulse (EMP) Engineering Surveillance program is a continuing program, as survivability of the EC-135 fleet must be ensured. Specific tasks necessary to conduct this effort will be identified as they occur.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Initial EC-135 System Level EMP Test Report | July 1986 |
| (2) (U) EC-135 System Level EMP Test | FY 1989 |

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0101313F
DOD Mission Area: 391 - Strategic Information Systems

Title: War Planning ADP-SAC
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 20,321 | 20,298 | 47,600 | 88,219 |
| 3769 | Strategic Mission Data Preparation System (SMDPS) | 0 | 20,321 | 20,298 | 47,600 | 88,219 |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The War Planning Automated Data Processing (ADP) effort for the Strategic Air Command (SAC) focuses on the maintenance and modernization of the ADP equipment, software and communications links necessary for planning and executing the strategic bomber, intercontinental ballistic missile (ICBM) and sea launched ballistic missile (SLBM) components of the nuclear TRIAD. The necessity to maximize force application dictates an ADP capability to effectively integrate while rapidly reacting to changes in enemy force deployment and composition. This requirement applies equally as well to conventional wartime missions. The SMDPS project complements an upgrade to the force level war planning ADP. It will ensure the automated mission planning support equipment for strategic bomber platforms and weapons are fully integrated within the new hardware and software architecture of the Strategic War Planning ADP. This effort consolidates several independent mission planning efforts within ongoing strategic bomber/weapon acquisition programs (B-52, B-1B, B-2, Air Launched Cruise Missile, Advanced Cruise Missile, TACIT RAINBOW, Short Range Attack Missile II and other programs). The principal objective is to ensure that all of these programs will be compatible with SAC's new War Planning ADP. The common automated hardware and software architecture will facilitate system interoperability and decrease total acquisition costs for future weapon systems.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 0 | 20,321 | 20,298 | 0 | 0 |

(U) EXPLANATION: Funds previously included within associated programs identified in paragraph 5.

Program Element: 0101313F
DOD Mission Area: 391 - Strategic Information Systems

Title: War Planning ADP-SAC
Budget Activity: 3 - Strategic Programs

4. (U) **OTHER APPROPRIATION FUNDS: ($ in thousands)**

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 11,102 | 12,006 | 7,772 | 78,771 | 109,651 |
| Quantities | | 6 | 5 | 35 | 46 |

5. (U) **RELATED ACTIVITIES:** This project consolidates the war planning ADP support efforts within numerous strategic programs. These programs include, but are not limited to, B-52 (PE 0101113F), B-1B (PE 0604226F), B-2 (PE 0604240F), Air Launched Cruise Missile (PE 0604361F), Advanced Cruise Missile (ACM) (PE 0101120F), TACIT RAINBOW (PE 0207316F), Short Range Attack Missile II (PE 0603364F) and other programs.

6. (U) **WORK PERFORMED BY:** The primary contractor for integrating the conventional strategic weapons mission planning requirements is the Boeing Military Airplane Company (BMAC) of Wichita, Kansas. BMAC is also on interim contract to support integration of nuclear weapon mission planning requirements pending source selection. Nuclear weapon integration contract award is expected in April 1988. The initial period of performance will run to October 1991. These efforts will complement the in-house development of the parent SAC War Planning ADP software.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:** Not Applicable.

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1989:**

(U) Project: 3769, Strategic Mission Data Preparation System (SMDPS)

A. (U) Project Description: SMDPS is a multifaceted project supporting all of SAC's strategic bomber war planning requirements. It consists of three complementary efforts: upgrading the existing nuclear mission planning software to accommodate ongoing changes in new weapon systems such as the B-1B and ACM (SMDPS Phase II); integrating all strategic bomber platforms/weapons into the new SAC War Planning ADP hardware/software architecture (SMDPS Phase III); and developing a Conventional Mission Planning and Production System (CMPPS) to support smart standoff weapons. These efforts were previously funded within the individual programs. Consolidating these efforts within a single program element, managed by a single system program office, will provide the necessary control to avoid duplication of effort and preclude fielding non-interoperable mission planning systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The Boeing Military Airplane Company (BMAC) is on contract under the SMDPS Phase II effort to develop, test and deliver annual updates to the existing mission planning software to complement ongoing changes in the operational flight software for the B-52, B-1B, Advanced Cruise Missile (ACM) and Air Launched Cruise Missile. The FY 1987 effort included the development and delivery of Tape 5, which incorporated the ACM and B-1B defensive system updates. BMAC also started development of Tape 6, which will incorporate the Integrated Conventional Stores Management System capability for gravity weapons and B-1B defensive system improvements. Efforts to begin the transition to SMDPS III, the new standardized mission planning architecture, were initialized leading to a Preliminary Design Review in July.

(2) (U) FY 1988 Program: BMAC will complete development and testing of SMDPS Phase II Tape 6 and begin development of Tape 7 in April. The formal contract to manage the transition to SMDPS Phase III, the new standardized mission planning architecture, will be awarded in April. The Conventional Mission Planning and Production System (CMPPS) effort, which was contracted in December, will lead to a Preliminary Design Review in March and a Critical Design Review in June. Tape development and testing will be an iterative process, culminating with delivery of the first production tape in August. The complementary deployable mission planning hardware systems will begin delivery this year.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: SMDPS Phase II Tape 7, which will incorporate ACM and B-1B defensive system updates, will complete development and testing and be delivered in April. This development is a sequential process which begins with software coding, transitions to the merging of individual software modules/initial integration testing, followed by iterative recoding/retesting of the software and culminates in a final "end-to-end" software verification test. Tape 8, the last deliverable SMDPS Phase II product, will begin development upon delivery of Tape 7. The SMDPS Phase III effort will focus on managing the program to rehost existing Phase II software onto the new mission planning hardware and developing the Interface Control Documents to integrate new weapon systems (B-2, SRAM II, other programs) into this new architecture. This will support the procurement and delivery of the first SMDPS Phase III mission planning hardware in early FY 1990. The CMPPS effort will focus on the integration and testing of additional weapons (TACIT RAINBOW and other programs).

(4) (U) Program to Completion: The SMDPS Phase II effort will be completed in FY 90. The SMDPS Phase III transition effort will continue until the delivery of operable mission planning systems to all SAC bomber bases is complete. It will then continue to support integration of developing strategic weapon systems (B-2, SRAM II) until each system achieves its respective initial operational capability (IOC) milestone. The CMPPS effort will be completed in conjunction with the IOC for the systems it supports.

C. (U) Major Milestones:

| Milestones | Date |
|---|---|
| (1) (U) CMPPS Contract Award | Dec 87 |
| (2) (U) SMDPS Phase III Contract Award | Apr 88 |
| (3) (U) SMDPS Phase III IOC | Jan 90 |
| (4) (U) SMDPS Phase II Completion | Apr 90 |
| (5) (U) CMPPS IOC | Special Access Required |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102310F
DOD Mission Area: 391 - Strategic Information Systems

Title: NCMC - Tactical Warning/Attack Assessment (TW/AA) Systems
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 34,923 | 57,624 | 70,616 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program funds the major portion for replacement systems for the Tactical Warning/Attack Assessment (TW/AA) command, control, and communications architecture centralized within the North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex (NCMC). The requirement to rapidly replace current operational systems is documented in numerous Air Force, Department of Defense, and General Accounting Office reports

Software is becoming increasingly difficult to modify in response to the threat changes, upgrades in sensor capability and changes in information displays. This replacement program is designed, in combination with other parallel efforts referenced in paragraph 5, to incrementally upgrade and replace the current operational systems and facilities in accordance with the Joint Chiefs of Staff approved Integrated Tactical Warning and Assessment Architecture. Once completed, this architecture will provide the Commander-In-Chief (CINC) United States Space Command, CINC-Strategic Air Command, the National Command Authority, other Unified and Specified CINCs, and command centers with automated computer based command, control, and communications systems capable of meeting the tactical warning needs of the United States well into the next century.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 31,217 | 57,849 | 52,582 | Continuing | N/A |
| Other Procurement | 2,285 | 8,240 | 19,269 | Continuing | N/A |

EXPLANATION: (U) Programs in this Program Element (PE) and PE0102436F were restructured in December 1987 to eliminate budget disconnects over the Five Year Defense Plan. The additional $18,034K RDT&E funds as well as the reduction of $6,161K of Other Procurement funds for FY 1989 results from the restructure plan that required a transfer/payback of $11,100K of FY 1989 RDT&E funds from PE0102436F and the conversion of $7,000K of FY 1989 Other Procurement funds to RDT&E funds within PE0102310F. FY 87, + 3,706K RDT&E funds from PE0102436F to support faster development of the Granite Sentry program.

Program Element: 0102310F
DOD Mission Area: 391 - Strategic Information Systems

Title: NCMC - Tactical Warning/Attack Assessment (TW/AA) Systems
Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 3,485 | 8,036 | 15,797 | Continuing | N/A |
| Quantities | Not applicable | | | | |

5. RELATED ACTIVITIES: This program provides the major portion of replacement systems for the upgrade of the US and North American Aerospace Defense (NORAD) Command, Control, and Communications Architecture. PE0102436F, Command Center Processing and Display System, provides a replacement system for the missile warning systems within the architecture. PE0102311F, NCMC Space Defense Systems, is providing an upgrade to the Space Defense Operations Center and NORAD Space Surveillance Center for control of US space assets and cataloging/monitoring of all space objects. Sensor programs, also currently being upgraded, which form the major external elements to the Integrated Tactical Warning and Assessment Architecture include the Ballistic Missile Early Warning System (PE0102423F), Sea Launched Ballistic Missile Early Warning System (PAVE PAWS) (PE0102432F), and SPACETRACK (PE0102424F).

6. (U) WORK PERFORMED BY: The effort is managed by Air Force Systems Command's (AFSC) Electronic Systems Division (ESD), Hanscom AFB, MA. The Communications System Segment-Replacement (CSS-R) contractor is GTE Sylvania, Needham, MA. The Survivable Communications Integration System (SCIS) contractor is E Systems Incorporated, ECI Division, St. Petersburg, FL. The Granite Sentry development hardware contractor is Digital Equipment Corporation, Government Systems Group, Colorado Springs, CO while Air Force Space Command is developing application software under ESD management and with the assistance of Martin Marietta Corporation, Data Systems Division, Englewood, CO through GSA contract number GS-09F-50007. Technical support is provided by MITRE Corp., Bedford, MA. A contractor for the Offutt Processing and Correlation Center (OPCC) has not been selected.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0102310F North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) - Tactical Warning/Attack Assessment (TW/AA) Systems

A. (U) Project Description: The North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) upgrade and replacement of Tactical Warning/Attack Assessment (TW/AA) systems will provide automated and modularized computer based systems. This program is divided into the following four major efforts: (1) The Communications System Segment-Replacement (CSS-R) subsystem will replace current computers and software to process all communications in and out of the NCMC; (2) The Survivable Communications Integration System (SCIS) will provide for the transmission of pre-attack and trans-attack communications from sensors, receipt at and transmission from the NCMC and Offutt Processing and Correlation Center (OPCC), and receipt at other designated command centers; (3) Granite Sentry will provide a replacement for the NORAD Command Post facility and modernization of supporting computers and software in the Air Defense Operations Center, the Resource Center, and the Weather Center. Further, in coordination with other related programs, Granite Sentry will develop common work stations and displays for all NCMC systems; (4) The OPCC, a new start in FY 1993 and

based on Air Force Space Command approved Statement of Operational Need 03-85, will provide the secondary correlation center for processing integrated tactical warning and assessment data. These four programs will provide critical portions of space, ballistic missile and atmospheric tactical warning to the Commander-in-Chief (CINC)-North American Aerospace Defense (NORAD), CINC-United States Space Command, CINC-Strategic Air Command, and National Command Authorities. Each subsystem will be acquired in incremental blocks to provide measurable improvements in the operational capability of the command, control, and communications system over the entire acquisition period.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Testing of the Communications System Segment-Replacement (CSS-R) Block 1 computer programs, circuit health, and status monitoring functions of the technical control system has continued. Block 1 completed functional qualification testing and Air Force acceptance took place June 1987. The CSS-R Block 2 full-scale development/production was awarded in January 1987. Block 2 will eventually complete the CSS-R system by providing overall control of message distribution throughout the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC). CSS-R Block 2 completed a Preliminary Design Review in FY 1987 documenting completion of system engineering and high level software design. The Survivable Communications Integration System (SCIS) full scale development is continuing and completed a Preliminary Design Review. Numerous components and software modules were evaluated to validate system design and performance. Both initial and detailed software designs were completed and modularized testing of software was conducted in preparation for hardware/software integration tests. Granite Sentry purchased commercial off-the-shelf computer systems to aid in the design and development of software functions. The Preliminary Design Review for software was completed. No RDT&E funds were used for the Offutt Processing and Correlation Center (OPCC) in FY 1987. However, the OPCC facility design was completed.

(2) (U) FY 1988 Program: CSS-R Block 1 development will be completed. CSS-R Block 2 will complete design and modular unit testing of computers and software to distribute warning messages by completing the system Preliminary Design Review. Developmental testing will continue to complete hardware/software integration in preparation for Critical Design Review in FY 1989. The SCIS program will complete systems testing and hardware/software integration testing. Both contractor and Air Force in-plant development test and evaluation of SCIS will be initiated and a Critical Design Review will be conducted. Granite Sentry will conduct a Critical Design Review for the Air Defense Operations Center. A competitive request for proposal for the OPCC facility construction will be released and military construction will begin.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The CSS-R Block 2 program will complete hardware/software integration, a progress demonstration test and Critical Design Review. Contractor and Air Force in-plant development test and evaluation will be conducted. A Functional Qualification Test is also planned. Initial installation and checkout of the complete CSS-R will be finished in the Test Development and Training Center. SCIS will undergo systems testing during FY 1989. This will include successful completion of development test and evaluation and both physical and functional configuration audits. Granite Sentry will reach initial operational capability at the NCMC Air Defense Operations Center. The OPCC facility will be available to accept hardware from related TW/AA Programs. CSS-R cost estimates are Category I, comprehensive and based on actual contract prices. SCIS cost estimates are also Category I, based on the FY 1986 awarded contract. Granite Sentry cost estimates are category II, mature baseline estimates. OPCC cost estimates are Category IV, based on internal program office and using command cost estimates.

(4) (U) Program to Completion: These are continuing programs. Communications System Segment-Replacement (CSS-R) will undergo development and operational test and evaluation during FY 1990 and FY 1991. CSS-R will reach initial operational capability (IOC) in FY 1991. Survivable Communications Integration System (SCIS) will complete operational test and evaluation and reach IOC in FY 1991. Granite Sentry will reach IOC for the Command Post in FY 1990, transition completed systems to the newly operational CSS-R during FY 1991/FY 1992, and will reach full operational capability in FY 1994. RDT&E development of the Offutt Processing and Correlation Center (OPCC) will follow completion of the NCMC upgrades with contract award scheduled for first quarter FY 1993.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (01) | (U) | CSS-R Concept Definition contract award | | July 1983 |
| (02) | (U) | CSS-R Development Contract Award | | June 1984 |
| (03) | (U) | CSS-R Block 1 Critical Design Review (CDR) | | January 1985 |
| (04) | (U) | Granite Sentry Statement of Operational Need (SON) Validated | | June 1985 |
| (05) | (U) | SCIS development contract award | | August 1986 |
| (06) | (U) | OPCC SON validated | | November 1986 |
| (07) | (U) | CSS-R Block 2 start | | January 1987 |
| (08) | (U) | SCIS CDR | *(August 1987) | January 1988 |
| (09) | (U) | Granite Sentry Air Defense Operations Center Initial Operational Capabilty (IOC) | | December 1988 |
| (10) | (U) | Granite Sentry Command Post IOC | *(FY 1989) | FY 1990 |
| (11) | (U) | SCIS IOC | *(FY 1990) | FY 1991 |
| (12) | (U) | CSS-R IOC | | FY 1991 |
| (13) | (U) | CSS-R Full Operational Capability (FOC) | | FY 1992 |
| (14) | (U) | Granite Sentry FOC | *(FY 1992) | FY 1994 |
| (15) | (U) | SCIS FOC | *(FY 1992) | FY 1994 |

* Date presented in FY 1988/FY1989 Descriptive Summary

(U) Explanation of Milestone Changes

(08) (U) SCIS CDR delayed
(10) (U) Minor changes to content caused two quarter delay.
(11 & 15) (U) Restructure of programs (See paragraph 3 "Explanation") slipped SCIS IOC/FOC to be consistent with current development schedules of related programs. These include the Command Center Processing and Display System-Replacement (CCPDS-R) (0102436F) as well as availability of secure communications media such as the Ground Wave Emergency Network (GWEN).
(14) (U) Restructure of programs (See paragaphy 3 "Explanation") delayed the lower priority phases of Granite Sentry (i.e. Battle Staff Support Center and the Weather Cetner) until related programs of highter priority can be completed.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102311F | Title: NCMC - Space Defense Systems
DOD Mission Area: 391 - Strategic Information Systems | Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 42,882 | 23,410 | 22,982 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A Space Defense Command and Control System (SPADCCS) is needed to satisfy Presidential and Secretary of Defense directives to improve, in a balanced manner, the space defense capability of the United States. SPADCCS is not part of the ASAT Program. Current space defense operations lack real-time response and cannot satisfy new operational requirements. This program element supports the development of 1) the Space Defense Operations Center (SPADOC) to effectively manage all US space defense and surveillance activities through the 1990s; 2) to upgrade and integrate the activities of the US Space Command Space Surveillance Center (SSC) for cataloguing of space objects, orbit parameter computation, and associated interfaces to communications networks; and 3) to integrate the SPADOC and SSC onto a common architecture. Completion of this program is essential to replacing antiquated computer systems in the Cheyenne Mountain Complex (CMC).

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 39,125 | 26,371 | 24,004 | Continuing | N/A |
| Other Procurement | 10,438 | 4,248 | 9,118 | Continuing | N/A |

EXPLANATION: (U) There are no ASAT funds in this program element. The FY 1989 Other Procurement reflects funds for the purchase of SSC computers for SPADOC IV Block B which will be used for cataloguing of space objects. Differences in FY 1987 RDT&E and Other Procurement result from late fiscal year Congressionally approved RDT&E reprogramming and delays in procurement of computer hardware caused by the need to slow the work in FY 1987 while awaiting reprogramming action. FY 1988 differences are the result of reduced Congressional appropriations. The FY 1989 estimate is based on negotiated contracts which will complete SSC initial upgrade by year.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: Funds | 4,727 | 3,040 | 11,295 | Continuing | N/A |

PE: 0102311F

5. (U) RELATED ACTIVITIES: PE 0102424F, SPACETRACK, provides sensor data to SPADOC. SPADOC will provide survivability and warning information to the Consolidated Space Operations Center, PE 0303130F. This project does not provide any ASAT funding. This program modernizes computer systems essential to Space Surveillance Tactical Warning/Attack Assessment (TW/AA). PE 0102436F, Command Center Processing and Display System and PE 0102310F, NCMC-TW/AA Systems replace systems in the Air Defense and Missile Warning mission areas.

6. (U) WORKED PERFORMED BY: Air Force Systems Command's (AFSC) Space Division (SD), Los Angeles AFS, CA, is responsible for overall management of the Space Defense Command and Control System (SPADCCS) development. AFSC's Electronic Systems Division (ESD), Hanscom AFB, MA, is the acquisition/program management agency for the Space Defense Operations Center (SPADOC) effort. Ford Aerospace and Communications Corporation, Colorado Springs, CO, is the prime contractor; IBM, Gaithersburg, MD, is the major hardware subcontractor; and TRW, Colorado Springs, CO, is the major software subcontractor. System engineering contractors are Science Applications Incorporated, La Jolla, CA; Aerospace Corporation, Los Angeles, CA; and MITRE Corporation, Burlington, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0102311F, North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) - Space Defense Systems

A. (U) Project Description: Space Defense Operations Center (SPADOC) development will provide an integrated space defense and surveillance command and control capability. SPADOC will provide the necessary information to assess the status of operational US space assets as well as alerting, warning, and verification of hostile space events. In addition, SPADOC will provide an automated and highly accurate catalogue of all space objects and will be capable of meeting US defense requirements for the foreseeable future. Finally, SPADOC will provide the command control interface among space asset owners, operators, users, operational commanders, and the National Command Authority. SPADOC has evolved in phases from a totally manual system in 1979 to the current SPADOC III. The acquisition approach for SPADOC phase IV is in three separate yet overlapping development/procurement blocks. Each block is designed to provide the user with a measured phased improvement in capability. SPADOC IV Block A provides the basic SPADOC IV framework, facility renovation, hardware, executive level software, mathematical algorithms, and a measured increase in assessment and warning capability. SPADOC IV Block B will upgrade the US Space Command Space Surveillance Center (SSC) orbital generation capability for high interest satellites and increase the space object cataloguing capacity to satisfy the increased processing speed and data requirements imposed by the worldwide increased use of space. SPADOC IV Block C will complete the upgrade by assuming responsibility for all space object catalogue management and removing the space mission from the current 427M computers.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: SPADOC Block A began systems testing in the CMC and IOT&E in the Off-Site Test Facility. SPADOC Block B has completed over 50 percent of software development. SPADOC Block B Preliminary Design Review was completed as well as site preparation at the Off-Site-Test Facility (OSTF).

(2) (U) FY 1988 Program: SPADOC IV Block A will reach Initial Operational Capability in March 1988. Block B (Space Surveillance Upgrade) will conduct a Critical Design Review, begin system test dry runs in the Off-site test facility, and begin installation and checkout in the CMC.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Space Defense Operations Center (SPADOC) Block B initial Space Surveillance Center (SSC) upgrade, will reach Initial Operational Capability after completing systems testing in the off-site test facility followed by development and operational testing in Cheyenne Mountain. Detailed specifications and scheduling of the final phase of SPADOC IV, Block C—SSC replacement, will be completed. Contingent upon funding, Block C is scheduled to be awarded in FY 1989.

(4) (U) Program to Completion: This is a continuing program. SPADOCs Full Operational Capability of early FY 1992 may be delayed due to funding. This program will continue to develop computer programs and install interfaces for the Space Defense Command and Control System and will continue until the system can provide timely warning of space attacks, develop countermeasures and responses, and control US space weapon systems as determined by national policy.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (01) (U) Aerospace Defense Command Statement of Operational Need 3-79 | | December 1980 |
| (02) (U) SPADOC IV B Contract Award | | June 1986 |
| (03) (U) SPADOC IV A Initial Operational Capability (IOC) | | March 1988 |
| (04) (U) SPADOC IV C Contract Award | *(April 1989) | September 1989 |
| (05) (U) SPADOC IV B IOC | *(March 1989) | September 1989 |
| (06) (U) SPADOC IV C IOC and System Full Operational Capability | | December 1991 |

* Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes

(4) and (5) (U) Delayed Block A IOC date (March 1988) has delayed Block B IOC and Block C Award.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102313F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Ballistic Missile Tactical Warning/Attack Assessment (TW/AA) System
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 2,874 | 2,256 | 2,533 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides system engineering and design analysis support for the nation's ballistic missile TW/AA system. This effort was initiated to implement the recommendations of the October 1980 report to the Committee on Armed Services, United States Senate, which addressed, "Recent False Alerts from the Nations' Missile Attack Warning System". The report recommended the Secretary of Defense consolidate management of essential TW/AA resources under a single commander and provide a centralized management structure for TW/AA acquisition programs. The objectives of this program are to promote fully coordinated management and technical interoperability in the acquisition of new or upgraded TW/AA systems and prevent duplication of effort between programs.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 2,874 | 2,256 | 2,533 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The work in this program ensures the integration and coordination of development, acquisition and deployment efforts for missile warning sensor systems, communications systems and command centers. This program is related to all projects which support the Air Force tactical warning and attack assessment mission.

6. (U) WORK PERFORMED BY: Air Force Systems Command's Electronic Systems Division (ESD), Hanscom AFB, MA, is responsible for overall management of this program. ESD coordinates program engineering efforts with the Space Command System Integration Office to ensure user requirements are met and no duplicative projects are undertaken. Program funds pay for technical engineering support, including support from the Mitre Corporation, a Federal Contract Research Center, headquartered in Bedford, MA.

Program Element: 0102313F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Ballistic Missile Tactical Warning/Attack Assessment (TW/AA) System
Budget Activity: 3 - Strategic Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0102313F, Ballistic Missile TW/AA System

A. (U) Project Description: This program provides the management framework through which the Air Force will apply coordinated oversight of the acquisition and interface of missile warning systems. New TW/AA-related systems defined in the project are later transferred to separate Program Elements for development, acquisition and deployment. Integration will be ensured through the development of technical standards and implementation of protocols for communications interfaces and by development of detailed plans for command center processing and display of missile warning information. Management of the TW/AA assets as an integrated system is necessary to ensure accurate, timely and unambiguous warning and assessment information to support force survivability actions and national decision making.

B. (U) Program Accomplishments And Future Efforts:

(1) (U) FY 1987 Accomplishments: Continued operation of master schedule and interface management systems t management and engineering assistance to all TW/AA-related acquisition efforts. Provided system engineering and integration support for TW/AA acquisitions transitioning to Initial Operational Capability including Ballistic Missile Early Warning System Upgrade, PAVE PAWS Site III and IV, Communications System Segment Replacement, and the Survivable Communications Integration System. Pre-contract development work was accomplished for the NORAD Processing and Display System. Funding cited reflects the estimated level of effort for this project. No formal cost estimate is applicable.

(2) (U) FY 1988 Planned Program: Efforts will include cost effectiveness trade offs to determine appropriate methods of upgrading the tactical warning system to provide fully integrated attack warning capabilities to include all aspects of the projected air, space or missile threats to the United States.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: System engineering efforts in FY 1989 will evaluate the selected solutions to ensure on-going programs are meeting the defined system requirements and to monitor the overall system baseline performance. Individual program baselines will be defined and maintained for all required developments.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102325F
DOD Mission Area: 122 - Strategic Air Defense

Title: Joint Surveillance System (JSS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | 3,234 | 2,147 | 1,751 | Continuing | N/A |
| 2976 Atmospheric Tactical Warning Connectivity | 2,249 | 1,201 | 898 | Continuing | N/A |
| 2996 FAA/AF Radar | 985 | 946 | 853 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Joint Surveillance System (JSS) provides for air surveillance and command and control of air defense forces for airspace sovereignty. A joint-use network of Federal Aviation Administration (FAA) and military radars in the Continental United States (CONUS), Alaska, and Hawaii provide data to six Air Force Region Operations Control Centers and Sector Operations Control Centers (ROCCs/SOCCs) for air defense and to FAA Air Route Traffic Control Centers for air traffic control. Two JSS ROCCs were Canadian-acquired via Foreign Military Sales. US and Canadian JSS assets provide warning and threat assessment information to HQ North American Aerospace Defense Command (NORAD). The Atmospheric Tactical Warning Connectivity (ATWC) program will integrate the Over-the-Horizon Backscatter (OTH-B) radar system, North Warning System (NWS), and the Navy's Relocatable Over-the-Horizon Radar (ROTHR) into the JSS ROCCs. OTH-B, NWS, and ROTHR data must be provided to the ROCCs/SOCCs for improved airspace control and to allow selected target information to be forwarded to HQ NORAD for incorporation into raid recognition assessments. The FAA/AF Radar Replacement (FARR) program will replace forty (40) existing JSS search, beacon, and height-finding radars with solid-state, three-dimensional radars to improve mission performance and reduce operation and maintenance costs. The new radars will be incorporated into the FAA's National Airspace System, and the FAA will assume ownership and maintenance responsibility.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 3,267 | 2,156 | 1,754 | Continuing | N/A |
| Other Procurement | 12,142 | 37,549 | 33,155 | 133,635 | 360,784 |

EXPLANATION: (U) Net FY 1988 reduction of $3.4 million in Other Procurement is a result of undistributed adjustments for communications/electronics spares. Net FY 1989 Other Procurement increase of $23.5 million is a result of an increase of $30.8 million to cover a FARR repricing disconnect offset by reductions of $7.3 million for stock fund, initial and replenishment spares, and ROTHR/ROCC connectivity.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement, Total | 12,764 | 34,156 | 56,633 | Continuing | N/A |
| 968H (JSS) Funds | 100[1] | 2,285[2] | 3,800[2] | 39,348 | 45,533 |
| 2976 (ATWC) Funds | 8,044 | 4,045[3] | 0[4] | Continuing | N/A |
| 2996 (FARR) Funds | 0[5] | 26,422[6] | 52,541[7] | 221,364 | 300,327 |
| 968H, 2976, 2996 Funds (spares) | 4,620[8] | 1,404 | 292 | 15,082 | 21,398 |

Footnotes:
1. Two displays for the RSSF workbench.
2. Joint Surveillance System (JSS) HAVE QUICK anti-jam communications enhancements.
3. Includes $443 thousand for balance of printed circuit boards for ROCC Atmospheric Tactical Warning Connectivity (ATWC) modifications, $1,947 thousand for ROTH-R integration, and $1,655 thousand for dispersal communications.
4. Reflects deletion of $867 thousand for Region Operations Control Center (ROCC) software upgrades for Relocatable Over-the-Horizon Radar (ROTHR) compatibility due to undistributed PBD reductions.
5. Reflects Congressional reduction of $16,194 thousand due to contract award slip.
6. Includes $1,362 thousand for Alaskan Air Command North Coast Radar.
7. Reflects the addition of $30.8 million to fix a repricing disconnect in FY 1989.
8. Includes $3.1 million of initial spares for FARR to be applied in FY 1988.

5. (U) RELATED ACTIVITIES: Joint Surveillance System (JSS) Region Operations Control Centers (ROCCs) will receive surveillance data from Over-the-Horizon Backscatter (OTH-B) radars (PE 0102417F), the North Warning System (NWS) (PE 0102412F), and the Relocatable Over-the-Horizon Radar (ROTHR) system (PE 0604725N). The JSS system includes Alaskan Air Command surveillance radars modernized by SEEK IGLOO (PE 0102411F). JSS ROCCs interface with the E-3 Airbone Warning and Control System (PE 0207417F). Project 2967, Atmospheric Tactical Warning Connectivity (ATWC) will provide for near-term integration of OTH-B, NWS, and ROTHR; and follow-on integration of data into ROCCs/SOCCs from other planned radars for the Aleutians and the east coast of Canada. The joint-use JSS radar network is operated and maintained in accordance with Federal Aviation Administration (FAA)/Air Force National Agreement 614.

6. (U) WORK PERFORMED BY: Air Force program management for the JSS Region and Sector Operations Control Centers (ROCCs/SOCCs) is provided by Air Force Logistics Command, Wright-Patterson AFB, OH. The prime contractor for the JSS ROCCs/SOCCs is Hughes Aircraft Corporation, Fullerton, CA. Management for the Atmospheric Tactical Warning Connectivity project is provided by the Electronic Systems Division of Air Force Systems Command, Hanscom AFB, MA. The Federal Aviation Agency is the lead acquisition agency for the FAA/AF Radar Replacement Program in accordance with a 19 November 1984 sub-agreement to FAA/AF National Agreement (NAT) 711. The FAA and the Air Force have established a Joint Program Office at HQ FAA, Washington, D.C., for this procurement.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2976, Atmospheric Tactical Warning Connectivity (ATWC). The ATWC program will develop ROCC/SOCC hardware/software modifications that allow Over-the-Horizon Backscatter (OTH-B) radar systems and the North Warning System (NWS) to be integrated into the JSS ROCCs. This effort will also provide for data exchange between Air Force OTH-B and Navy Relocatable Over-the-Horizon Radar (ROTHR) systems. ATWC RDT&E also funds program office activities. This program will integrate OTH-B, Navy ROTHR, and NWS radar data into the ROCCs and SOCCs. Hardware modification will expand the memory capability of the ROCC computers and display processors in order that radar tracks from the above systems may be displayed to the ROCC/SOCC operators. The ROCC/SOCC software is being modified to display the OTH-B and NWS track data and pass the information to the North American Aerospace Defense Command Cheyenne Mountain Complex. FY 1986 studies were initiated on data processing and display requirements for integrating Navy ROTHR data. Alternative architectures to meet these requirements were developed. In FY 1987 and 1988 the alternative architectures for ROTHR were evaluated and one chosen for implementation. Initial development prototyping was begun for the chosen architecture. Also in FY 1987 and 1988, the initial ROCC/SOCC integration hardware for OTH-B and NWS was procured. In FY 1989, the selected integration hardware/software for the Navy ROTHR will continue development. FY 1989 RDT&E funds also provide technical engineering support for ATWC.

B. (U) Project: 2996, FAA/AF Radar Replacement. The FAA/AF Radar Replacement (FARR) Program will replace existing JSS search, beacon, and height-finding radars with solid-state, three-dimensional radars to improve mission performance and reduce operation and maintenance costs. The new radars will be incorporated into the FAA's National Airspace System, and the FAA will assume ownership and maintenance responsibility resulting in an Air Force JSS cost avoidance of approximately $48 million a year and savings of over 1000 critical manpower authorizations. In FY 1986, a draft Request for Proposal (RFP) was issued which will led to a final RFP in FY 1987 and contract award in June 1988. FY 1989 RDT&E funds provide technical engineering support for the FARR Joint Program Office.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102411F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Surveillance Radar Stations/Sites
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 15,917 | 5,204 | 1,667 | Continuing | N/A |
| 2980 | North Atlantic Defense Sys (NADS) | 6,636 | 4,326 | 828 | Continuing | N/A |
| 3137 | POTEEN | 8,398 | 0 | 0 | 0 | 12,544 |
| 3159 | Caribbean Radar Sys | 883 | 878 | 839 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element funds strategic air defense improvements. The NADS funds improvements to command, control, and communication ($C^3$) and surveillance equipment in the North Atlantic required to correct air defense deficiencies in Iceland

Existing $C^3$ and surveillance equipment will be ineffective if challenged in wartime. The current Iceland Air Defense and Early Warning System is manually operated, antiquated and deficient in radar coverage. The lack of automation and inadequate $C^3$ facilities precludes timely distribution and exchange of vital air defense information received from radar sites, airborne early warning systems, maritime forces, and adjacent NATO air defense ground environment systems.

With existing deficiencies, Soviet aircraft with cruise missiles can exploit the poor $C^3$ capability and the gap in radar coverage to attack critical targets in Iceland without warning.

This area is considered a linchpin of the Northern flank and the key to reinforcement of the entire NATO theatre. The Caribbean Basin Radar Network project provides ground-based radar systems and upgraded command, control, and communications capability for the US Commander-in-Chief Southern Command and the US Commander-in-Chief Atlantic Command. These ground radars will provide surveillance for attack warning, threat assessment, control of air defense/tactical forces, air traffic management, and drug and arms interdiction. The Air Force also provided the US Army funds for

CBRN Site 1 at Semaphore Hill, Panama, attained full operational capability in February 1988 as a first step in addressing the above threat. It will support Panama Canal and serve as part of a overall regional command and control system supporting assigned forces in the area.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 20,118 | 5,224 | 1,671 | Continuing | N/A |
| Other Procurement | 113,355 | 42,335 | 30,110 | Continuing | N/A |

EXPLANATION: (U) FY 1987 RDT&E difference results from reprogramming funds from POTEEN to ADI (3.999M) and Concept Development. Other RDT&E differences result from inflation adjustment. FY 1987 Other Procurement differences result from reprogramming funds into CBRN and spares adjustment. FY 1988 adjustments result from Congressional denial of funds for NADS due to a slip in contract award and direction from the Office of the Secretary of Defense to execute an undistributed reduction. FY 1989 differences result from spares adjustment.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Other Procurement: | 124,393 | 8,173 | 30,381 | Continuing | N/A |
| 2980 (North Atlantic Defense Sys) | | | | | |
| Funds | 21,343 | 1,122 | 2,059 | Continuing | N/A |
| Quantities | 4[2] | 0 | 0 | | |
| 3159 (Caribbean Basin Radar Network) | | | | | |
| Funds | 21,450 | 7,051 | 28,322 | Continuing | N/A |
| Quantities | 1[2] | 1[2] | 2[2] | | |
| Drug Interdiction Aerostat Radars | | | | | |
| Funds | 81,600 | 0 | 0 | 0 | 81,600 |
| Quantities | 5[3] | | | | |

Footnotes: 1. US Host Nation share of NATO Radar Subsystem
2. Ground radars/contractor operated and maintained
3. Aerostat-borne radars

5. RELATED ACTIVITIES: The North Atlantic Defense System (NADS) is planned as a conjunctively funded NATO infrastructure project. The Interim Automated Air Defense System (IAADS) will use a Joint Surveillance System (PE0102325F) Region Operations Control Center (ROCC).

6. (U) WORK PERFORMED BY: Efforts are managed by the Electronic Systems Division, Hanscom AFB, MA. Technical support is provided by MITRE Corporation, Burlington, MA; Rome Air Development Center, Griffiss AFB, NY; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD. The NADS Iceland Command and Control Enhancement (ICCE) contractor is Techdyne Systems Corp, Arlington, VA. General Electric Radar Systems Division, Syracuse, NY, is the contractor for the NADS NATO Radar Subsystem. Westinghouse Corp, Baltimore MD is the CBRN contractor.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 2980, North Atlantic Defense System. The purpose of the NADS program is to correct serious air defense deficiencies in Iceland The NADS project consists of three subprojects: 1) the Iceland Command and Control Enhancement (ICCE) project; 2) the Interim Automated Air Defense System (IAADS) project; 3) the NATO NADS project. The ICCE project will develop, procure and deploy an E-3 digital data link for Iceland. The IAADS project will acquire, install, integrate and check-out a Joint Surveillance System (JSS) Region Operations Control Center (ROCC), deploy an additional two FPS-93 search radars in northern Iceland, fully automated radar transmission from all four FPS-93s, and provide necessary communications. The IAADS is an interim system and will be eventually replaced by the fully capable NATO-acquired NADS. The NATO NADS is planned as a conjunctively funded NATO infrastructure project for which the United States will serve as host nation. The NATO NADS project will acquire and deploy a new Control and Reporting Center (CRC), and four new three dimensional (3-D) radars on Iceland. It will also upgrade the entire communications system. The CRC will serve as the facility for conducting all air operations. ICCE and Interim Air Defense Control Facility equipment for the IAADS were procured in FY 1985. The Type B cost estimate for the NATO program was completed and site surveys were done. ICCE software development began, construction equipment and materials were prepositioned at northern sites, and northern site access roads were started. FY 1987 RDT&E completed ICCE and IAADS software development and system engineering and final integration and testing began. Efforts began to develop interface between NADS and North American Aerospace Defense Command (NORAD) systems. The NATO NADS radar contract was awarded in FY 1987. The NATO NADS Command and Control Center Invitation for Bid will be released to potential contractors from NATO nations in FY 1988, and the contract will be awarded in FY 1989, using NATO Infrastructure funds. FY 1989 continues NATO NADS software development.

B. Project: 3159, Caribbean Basin Radar Network: The Caribbean Basin Radar Network project will provide radar systems and an upgraded command, control, and communications capability for US Commander-in-Chief Southern Command and US Commander-in-Chief Atlantic Command. The eight additional radars will be netted with five existing radars and command and control centers at Howard AFB, PN, to provide a surveillance capability for attack warning, threat assessment, control of strategic air defense/tactical aircraft, air traffic management, and drug and arms interdiction. The contract for CBRN was awarded in FY 1987, and map surveys were conducted for sites in Panama an Colombia. In FY 1988, actual site surveys will be conducted for two proposed Colombian locations, initial CBRN site offers will be made to the remaining host nations, Site 1 IOC/FOC and Region Operations Center austere Command & Control capability will be achieved. FY 1989-91 RDT&E funds are for CBRN program office support.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: The North Atlantic Defense System (NADS) will be procured as a NATO Infrastructure project, funded primarily by the NATO Infrastructure fund. The United States is acting as Host Nation for this project on behalf of Iceland, another NATO member country. NATO procurement will include two separate contracts competed under international competitive bidding (ICB) procedures. The first procurement will be for the radar segment, which will procure four new state-of-the-art L-band radars to be installed in new facilities provided by NATO. The contract for the radar segment will be let in January 1987. The second procurement will complete the currently planned NATO project, and will include a new Control and Reporting Center (CRC), new on- and off-island communications, automated data processing (ADP) equipment, and total system integration, to include the new radars. Contract award is planned for January 1988. NATO has already approved infrastructure funds for the radar segment, and is currently screening the Type-B Cost Estimate for the CRC, Communications, ADP, and system integration effort. The funding is expected to be approximately 99% NATO, based on recent discussions with the NATO Infrastructure Payments and Progress Committee. Cooperative agreements are also required for the CBRN. Host Nation Agreements delineating responsibilities and overall concurrence on the part of the Host Nation and the United States are being pursued in connection with each planned CBRN location through State Department channels.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102417F | Title: Over-the-Horizon Backscatter (OTH-B) Radar
DOD Mission Area: 332 - Strategic Surveillance & Warning | Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 29,895 | 31,326 | 19,201 | 87,416 | 479,085 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops an Over-the-Horizon Backscatter (OTH-B) radar to satisfy requirements for tactical early warning of an attack on North America by bombers and air-to-surface missiles. Development of the OTH-B radar provides long-range wide area surveillance at all altitudes. It will detect and track airborne vehicles at ranges between approximately 500 and 1800 nautical miles from the radar. OTH-B increases warning time for survival of retaliatory forces and provides decision time for the National Command Authority consistent with ballistic missile warning requirements. It also significantly enhances redeployment options of available defense forces. The OTH-B will provide surveillance coverage of the east, west, and southern approaches to North America. Surveillance coverage in the north between the East and West Coast Systems will be provided by the North Warning System (PE 0102412F).

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total |
|---|---|---|---|---|---|
| RDT&E | 31,696 | 38,396 | 19,218 | 90,646 | 479,402 |
| Other Procurement | 112,882 | 133,504 | 317,674 | 609,281 | 1,774,825 |

EXPLANATION: (U) FY 1987 RDT&E difference results from a reprogramming of funds to support Space Booster Program. Congressional action reduced FY 1988 RDT&E by $6.9M. FY 1989 Other Procurement and RDT&E changes reflect program restructure to procure one sector per year through FY 1994 vice two per year through FY 1991.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 112,882 | 136,944 | 178,878 | 975,567 | 2,001,291 |
| Quantities (60 Degree Sectors) | 1 | 1 | 1 | 5 | 11 |
| Military Construction: | | | | | |
| Funds | | 7,300 | 17,500 | 118,374 | 239,352 |

5. (U) RELATED ACTIVITIES: The Over-the-Horizon Backscatter (OTH-B) radar system is being developed to provide all-altitude tactical early warning in support of our strategic air defense mission. The OTH-B will be compatible with related programs such as the North Warning System Radars (PE 0102412F), the Joint Surveillance System (PE 0102325F), and air defense interceptor forces. The OTH-B system will send track information to the Region and Sector Operations Control Centers of the Joint Surveillance System and to the North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex. Communications will be provided under OTH Radar Systems Communications (PE 0102444F). Related OTH radar developments by the Office of Naval Research and the Navy Space & Naval Warfare Systems Command are monitored by the Air Force.

6. (U) WORK PERFORMED BY: The development of the OTH-B radar system and supporting OTH technical efforts are managed by the Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA. The radar prime contractor is the General Electric Co., Syracuse, NY. Major subcontractors include General Telephone and Electronics Corp, Waltham, MA; General Electric Co., Huntsville, AL; Continental Electronics, Dallas, TX; and TRW, Redondo Beach, CA. Continuing OTH technical efforts, analysis, engineering studies and support are provided by: Rome Air Development Center, Griffiss AFB, NY; SRI International Remote Measurement Laboratory, Menlo Park, CA; Naval Research Laboratory, Washington, D.C.; MITRE Corporation, Bedford MA; and the Air Force Geophysics Laboratory, Hanscom AFB, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0102417F, Over-the-Horizon Backscatter (OTH-B) Radar

A. (U) Project Description: This RDT&E portion of the project converts the Experimental Radar System (developed by PE 63703F CONUS Over-the-Horizon Radar) into the initial 60 degree azimuthal coverage sector of the East Coast Radar System, integrates the first two production sectors to this sector to form the complete system, and tests the fully integrated system. Procurement and military construction funds budgeted for the project will allow acquisition of a 180 degree azimuthal coverage system on each coast of North America, a 240 degree coverage system in the Central United States for southern area surveillance and coverage of the ocean areas as a complement to the East and West Coast Systems, and a 120 degree coverage system in Alaska for Aleutian Island air defense. A Pre-Planned Product Improvement ($P^3I$) Program will be conducted.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The RDT&E funds were used to begin integrating the initial sector to the first two production sector to form the East Coast Radar System (ECRS). A 22-month slip in the ECRS schedule arose due to delays in completing software for final auxiliary functions for performance monitoring and fault location, and automatic computer system switchover to back-up computers. The final Environmental Impact Statements for candidate Alaskan and Central Radar Systems sites were prepared and a Record of Decision for Alaskan sites was issued. Procurement of the West Coast Radar System continued.

Program Element: 0102417F — Title: Over-the-Horizon Backscatter (OTH-B) Radar

DOD Mission Area: 332 - Strategic Surveillance & Warning — Budget Activity: 3 - Strategic Programs

(2) FY 1988 Program: Tests with the ECRS to verify the conclusions reached in FY 1986 on the capability to detect and track cruise missiles will be conducted. These tests will include the use of AOM-34 drones modified to simulate the radar cross section of cruise misile. Limited Operational Training Capability (LOTC) will be initiated. Results of the small-target testing will form the basis for development of system improvements for the Alaskan and Central Radar Systems The final sector of the West Coast Radar System will be procured.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Initial Operational Test and Evaluation (IOT&E) will be performed on the integrated ECRS. Development of system improvements for cruise missile detection will continue. A procurement contract for the Alaskan Radar System will be awarded. This contract will procure the first sector and will contain a priced option for the second sector. Cost estimates are mature, category II.

(4) (U) Program to Completion: The second sector of the Alaskan Radar System will be procured in FY 1990, and procurement of the Central Radar System (CRS) will commence in FY 1991 at a rate of one sector per year. The second, third, and fourth sectors will be priced options on the FY 1991 contract. The CRS will incorporate the additional systems enhancements previously developed to improve cruise missile detection capability.

C. ( ) Major Milestones:

| | Milestones | | Dates |
|---|---|---|---|
| (1) | (U) System Definition Complete | | November 1973 |
| (2) | (U) Prototype Contract Award | | March 1975 |
| (3) | (U) Initiate Program Restructuring | | December 1976 |
| (4) | (U) Conclude Technical Feasibility Test | | February 1981 |
| (5) | (U) Conclude Partial Initial Operational Test and Evaluation | | June 1981 |
| (6) | (U) Air Force System Acquisition Review Council (AFSARC) Review | | November 1981 |
| (7) | (U) Development Decision | | January 1982 |
| (8) | (U) Development Contract Award | | June 1982 |
| (9) | ( ) Initial Operational Capability (IOC) - East | | |
| (10) | ( ) IOC - West | | |
| (11) | ( ) IOC Alaskan Radar System | | |
| (12) | ( ) Full Operational Capability (FOC) Central Radar System | | |

*Date presented in FY 1988/FY 1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(9) (U) East Coast Radar System IOC date slipped 22 months due to delays in completing software for auxiliary functions, performance monitoring and fault location, and integrated three-sector operation.

PE: 0102417

(12) (U) The Central Radar System FOC date slipped due to a program restructure to procure one sector per year through 1994.

9. (U) COOPERATIVE AGREEMENTS: The United States has a project agreement with Australia for the exchange of OTH-B research data. The agreement began in 1980. The Australian's have an experimental OTH-B radar that they are converting into an operational radar for the Royal Australian Air Force. They plan to procure three additional systems. A cooperative OTH radar program is being conducted with the UK under program element 12411F, Surveillance Radar Stations and Sites. The Navy is approaching several nations over cooperative arrangements for location of the Navy's OTH radar system. Under the terms of the Memorandum of Understanding on the Modernization of North American Air Defense System, signed in 1985, Canada will provide some manpower for operation of the East Coast, West Coast, and Central OTH-B Radar Systems.

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The OTH-B Radar System is currently in full scale development. The initial sector has operated since January 1986. Sectors 1 and 3 of the East Coast Radar System (ECRS) began limited operation on December 1, 1987. Sector 2 will begin operation in July 1988. AF DT&E will be performed using the complete ECRS beginning in July 1989.

(U) The initial sector is an upgrade to the earlier Experimental Radar System (ERS) which had a complete DT&E and Initial Operational Test and Evaluation (IOT&E) conducted by Air Force Systems Command (AFSC) and Air Force Operational Test and Evaluation Center (AFOTEC) personnel. These activities proved that the key system characteristics (listed in paragraph 3 below) could be satisfied by an operational system.

(U) The OTH-B program manager is Col J. A. Lee, Electronic Systems Division (ESD), Hanscom AFB, MA. The development program prime contractor is General Electric (GE) Electronic Systems Division, Syracuse, New York. ESD is responsible for all DT&E. They will use the services of the following organizations to accomplish DT&E: MITRE Corp, GE, Stanford Research Institute International, Rome Air Development Center, AF Geophysics Laboratory, Naval Research Laboratory and the Federal Aviation Administration. The software will be independently verified and validated by Scientific Systems Inc and Calspan Corp. The Tactical Air Command (TAC), Strategic Air Command, Military Airlift Command (MAC), and AFSC will supply aircraft for the operational tests and TAC will supply the radar operators. GE will maintain the East Coast Radar System (ECRS) during DT&E.

2. (U) Operational Test and Evaluation (OT&E):

(U) Experimental Radar System (ERS)

(U) The AFOTEC conducted a limited IOT&E from 1 March through 4 June 1981 on the ERS. The IOT&E was conducted primarily at the ERS combined receiver and operations site near Columbia Falls, Maine. Some testing was conducted at the transmitter site near Moscow, Maine.

(U) The results of the limited IOT&E on the ERS are documented in the OTH-B ERS IOT&E Final Report, July 1981 (Secret). This report details the operational deficiencies noted during testing. The report recommended the operational concept for the OTH-B be reviewed and updated with new performance requirements. The user subsequently updated the System Operations Concept (SOC) to reflect the new performance requirements.

(U) East Coast Radar System (ECRS)

(U) AFOTEC will conduct a dedicated IOT&E on the ECRS. The IOT&E period is currently planned for 1 October 1989 to 31 January 1990. During testing, AFOTEC will evaluate the operational effectiveness and suita-

bility of the integrated, 180-degree ECRS. Testing will include evaluation of radar performance, external interfaces, utility of OTH-B data forwarded to air defense centers, and system availability. AFOTEC has activated OL-PK in Bangor, ME., the operating location where the IOT&E test team will be located. The test team will have participating members from Tactical Air Command (TAC), Military Airlift Command (MAC), Air Force Space Command, Air Force Communications Command (AFCC), Air Training Command (ATC), Air Force Logistics Command (AFLC), and AFOTEC. Test scenarios are being structured to exercise the radar in individual segments and integrated combinations of segments. Overall radar operations from end-to-end will be emphasized throughout the test period.

(U) The IOT&E has two primary purposes:

(U) Ensure the OTH-B supports NORAD's atmospheric attack warning mission.

(U) Identify operational deficiencies which, when corrected, improve the overall effectiveness of OTH-B as an air defense sensor system.

(U) The critical operational issues that the IOT&E objectives and effectiveness measures address are:

(U) Does the OTH-B provide adequate and timely surveillance data to NORAD's integrated tactical warning and assessment (ITW&A) system?

(U) Does the OTH-B interoperate effectively with other systems and supporting agencies?

(U) Does OTH-B availability support NORAD's requirements as stated in the revised SOC?

3. (U) Systems Characteristics:

| Characteristic | Objective; Threshold | Demonstrated |
|---|---|---|
| **OPERATIONAL** | | |
| 1. RAID DETECTION**(Probability/% of time) | [ ] | [ ] [ ] |
| 2. AVAILABILITY | [ ] | -- |
| 3. (U) MEAN TIME BETWEEN FAILURES (Hours) | 40; 20 | -- |

* This data was derived from one year of tests, under various seasonal/diurnal conditions, and at all ranges. Seasonal average data are based on Development Test and Evaluation (DT&E) results, other averages are based on Initial Operational Test and Evaluation (IOT&E) results.
** A raid consists of twenty or more aircraft or air-breathing missiles.

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Budget Activity: 3, Strategic Programs
Program Element: 12417F, Over-the-Horizon Radar System

| Characteristic | Objective;Threshold | Demonstrated |
|---|---|---|
| **TECHNICAL** | | |
| 1. (U) DETECTION/TRACKING RANGE (NM) | 500-1800; 600-1500 | 500-1800 |
| 2. ABSOLUTE ACCURACY (RMS) (NM) | [ ] [ ] | [ ] [ ] |
| 3. SPEED RESOLUTION (KTS) | [ ] [ ] | [ ] [ ] |

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| Sector 3 Detection & Tracking | June 1987 | July 1987 | |
| Sector 3 Antenna Pattern Measurements | Sept 1987 | Sept 1987 | |
| Limited Operations Capability Demo | Nov 1987 | Nov 1987 | |
| Limited Operations Sector 1 OR Sector 3 | Dec 1987 | Dec 1987 | |
| Small Target Test | Jan 1988 | Jan 1988 | RPV Flight Test complete Mar 1988<br>Engineering Tests complete July 1988 |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Limited Operations Sector 1 AND Sector 3 | Apr 1988 | Simultaneous Detection and Tracking with both sectors |
| Updated TEMP Approved | May 1988 | |
| Limited Operations with all three Sectors | Nov 1988 | Simultaneous Detection and Tracking |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102423F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Ballistic Missile Early Warning System (BMEWS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 15,338 | 19,172 | 25,362 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The mission of BMEWS is to detect and provide warning of a ballistic missile attack on the United States, Canada, the United Kingdom and Europe. There are three sites located at Thule, Greenland; Clear, Alaska; and Fylingdales, England. The BMEWS was built in the late 1950s and early 1960s. At the time, the Soviet threat consisted of a relatively small number of single warhead missiles, and our national nuclear strategy was one of massive retaliation. The system was originally designed to predict missile impact points by tracking the large, easy to detect, rocket booster and extrapolating the ballistic path of the single warhead. As the system has aged, portions of it have become increasingly difficult to support.

As a result, the system is being modernized with radar upgrades, to include new computer resources, at the Thule and Fylingdales sites. This will ensure reliable performance and better support the national nuclear retaliatory strategy of flexible response.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 15,385 | 19,247 | 27,007 | Continuing | N/A |
| Other Procurement* | 49,535 | 4,449 | 2,656 | Continuing | N/A |

*Includes spares

(U) The differences in funding levels reflect reduction due to delays in program execution.

Program Element: 0102423F　　Title: Ballistic Missile Early Warning System (BMEWS)
DOD Mission Area: 332 - Strategic Surveillance and Warning　　Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 44,514 | 4,328 | 2,413 | Continuing | N/A |
| Quantities | | Not Applicable | | | |

5. RELATED ACTIVITIES: BMEWS is part of the national system for Tactical Warning and Attack Assessment. It confirms initial launch detection information provided by the [ ] and complements the information provided by the Sea Launched Ballistic Missile Detection and Warning network (PE 0102432F) and the North American Aerospace Defense Command (NORAD) Space Detection and Tracking System (PE 0102424F).

6. (U) WORK PERFORMED BY: The prime contractor for the Thule radar upgrade is Raytheon Corporation, Wayland, MA, with Control Data Corporation, Minneapolis, MN (computers), and TRW, Redondo Beach, CA (software) as subcontractors. The program is managed by Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA, in conjunction with the NORAD, Space Command, and Air Force Communications Command. General system engineering is provided by the Mitre Corporation, Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 12423F, BMEWS

A. Project Description: The BMEWS modernization program will assure continued reliable operation of our Intercontinental Ballistic Missile warning network by upgrading the radars and data processing equipment at the Thule and Fylingdales sites. These improvements will solve system support problems associated with obsolescent equipment and increase the system's capability to detect, track and provide accurate and timely warning of the [ ] The Fylingdales modernization will replace the site's three existing tracking radars with a three-faced phased array radar. In each case, data processing capability is being expanded and new software is being implemented to allow the radars to report on a much larger number of smaller, more closely spaced objects. [ ] will be solved and the system missile count capability will be significantly improved. This will greatly increase the system's tactical warning capability and also provide more accurate attack assessment information.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Upgrade of the Thule site was completed and IOC achieved in June 1987.

(2) (U) FY 1988 Program: The Fylingdales upgrade effort will begin with software development, system engineering and equipment fabrication. Major design reviews will be conducted and in-plant testing for hardw re and software will begin at the component and subsystem level. Structural design efforts will be completed, and UK-funded facility construction will be started by a UK firm under subcontract to the US prime contractor. The new software will ensure maximum exploitation of the much greater target handling capacity of the new phased array radars. Although proven technology is being used for the modernization, siting considerations and potential ballistic missile trajectories uniquely associated with Fylingdales dictate a significant workload for system engineering, software development and test. The Category II mature estimate for the Fylingdales upgrade is based on program office experience gained in the closely related Thule upgrade and the four-site PAVE PAWS Expansion Program.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Software development reviews and in-plant development testing at the system level will be completed in FY 1989 for the Fylingdales upgrade. Facility construction will continue through FY 1989 in concert with the installation of radar hardware integral to the facility structure (e.g., radar array plate assemblies). Construction, acceptance testing and discrepancy resolution for the facility will be completed. Computer and radar equipment installation and checkout will be completed and on-site integration and testing will begin in FY 1990. The Category II mature estimate for the Fylingdales upgrade is based on program office experience gained in the closely-related Thule upgrade and the four-site PAVE PAWS Expansion Program.

(4) (U) Program to Completion: The Fylingdales site will attain IOC in FY 1992. The BMEWS modernization is a continuing program; additional upgrade efforts will be implemented as necessary to accommodate Tactical Warning/Attack Assessment requirements.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Fylingdales Radar Upgrade Contract Award | *(August 1986) | March 1988 |
| (2) (U) Thule Radar Initial Operational Capability (IOC) | | June 1987 |
| (3) (U) Fylingdales Radar IOC | | FY 1992 |

*Date presented in FY 1988/FY1989 Descriptive Summary

(U) Explanation of Milestone Changes

(1) (U) Delay in procurement start because of extensive preliminary negotiations with United Kingdom and the contractor.

9. (U) COOPERATIVE AGREEMENTS: An agreement was signed with the United Kingdom on 13 October 1986 on the Fylingdales radar upgrade. The United Kingdom will pay for the facilities and operations and maintenance of the radar and the US will purchase the radar. Additionally, the facilities work will be performed by a United Kingdom subcontractor on the prime contract to be managed by the United States.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102424F  Title: SPACETRACK
DOD Mission Area: 332 - Strategic Surveillance and Warning  Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR | PROGRAM ELEMENT | 14,319 | 7,600 | 9,357 | Continuing | N/A |
| 2295 | Ground-Based Electro-Optical Deep Space Surveillance System | 4,061 | 1,000 | 1,400 | Continuing | N/A |
| 2296 | Space Surveillance Network Improvement Program | 10,258 | 3,600 | 3,957 | Continuing | N/A |
| 3202 | Air Force Maui Optical Station | * | 3,000 | 4,000 | Continuing | N/A |

* Funding for this project is in Project 2296 until FY 1988

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Soviets continue to pursue a dynamic and expanding military space program, including an operational antisatellite (ASAT) system and satellite reconnaissance systems which are integrated with their ground forces. Our current space surveillance network (SPACETRACK) has

This program integrates near- and far-term operational systems into SPACETRACK in support of satellite attack warning and verification,

These research and development efforts will: (1) support the deployment of a five-site global ground-based electro-optical deep space surveillance system (GEODSS)

(2) provide

through the Pacific corridor with Pacific radars including the Defense Advanced Research Projects Agency (DARPA) Long-Range Tracking and Instrumentation Radar on Kwajalein and GPS-10 radar in the Philippines; (3) provide rapid and accurate calibration of SPACETRACK radars using the Navy Transit satellites; (4) upgrade the Air Force Maui Optical Station, Haystack and Kaena Point sites to support SPACETRACK space object identification, and operational satellite mission assessment and (5) provide

extended range capability for selected SPACETRACK radars and develop a deep space surveillance radar. Mission need is documented in Air Defense Command Statement of Need 3-79 and Air Force Mission Element Need Statement for an antisatellite capability (validated by Secretary of Defense).

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 14,385 | 9,630 | 10,966 | Continuing | N/A |
| Other Procurement | 5,549 | 1,777 | 1,636 | Continuing | N/A |

EXPLANATION: (U) FY 1988 RDT&E reduction due to Congressional action.
(U) FY 1989 RDT&E reduction due to higher priority programs.
(U) FY 1989 Other Procurement reduction due to higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS ($ in thousands):

| | | | | | |
|---|---|---|---|---|---|
| Other Procurement | 5,549 | 1,570 | 598 | Continuing | N/A |
| Military Construction | 5,200 | 0 | 0 | Continuing | 27,580 |

5. (U) RELATED ACTIVITIES: SPACETRACK is part of the Space Defense Systems Program involving four functional areas: Antisatellite, Space Surveillance, Space System Survivability, and Command and Control. SPACETRACK is integrated with those programs which comprise the Space Defense Systems Program: PE 0604406F, Space Defense System; PE 0102450F, Space Defense Operations; PE 0603438F, Satellite System Survivability; and PE 0102311F, North American Aerospace Defense Cheyenne Mountain Complex Space Defense Systems. The baseline and technology for the Ground Based Electro-Optical Deep Space Surveillance (GEODSS) System and the SPACETRACK improved radar calibration, extended range and radar imaging upgrades were developed and demonstrated under PE 0603428F (now absorbed into the Strategic Defense Initiative Program, PE 0603220D).

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters Space Division, Los Angeles AFS, CA (Project 2296), Headquarters Electronic Systems Division, Hanscom AFB, MA (Project 2295) and Rome Air Development Center, Griffiss AFB, NY (Project 3202). TRW, Redondo Beach, CA, is the prime contractor for the GEODSS. GEODSS subcontractors are ITEK (cameras), Lexington, MA; Contraves Georz (telescopes), Pittsburgh, PA; and Kentron (operations and maintenance) Honolulu, HI. Avco Everett Research Laboratories, Everett, MA, operates the Maui Optical Tracking and Identification Facility and conducts research and development at the Air Force Maui Optical Site. Western Space and Missile Center is Space Division's agent for Kaena Point SPACETRACK improvements. General systems engineering and technical support is provided by Lincoln Laboratory, Lexington, MA; Mitre Corporation, Bedford, MA; and Aerospace Corporation, Los Angeles, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 2295, Ground-Based Electro-Optical Deep Space Surveillance (GEODSS) System: Provides a global network of five sites to optically detect, track and identify satellites in earth orbit at altitudes of 3,000 to 22,000 nautical miles and beyond. Deployment of first three sites and Program Management Responsibility Transfer were completed in FY 1983. The GEODSS Test System (CTS) was built to reduce risk in meeting Initial Operational Capabilities (IOCs) for the Diego Garcia and Portugal sites. In FY 1987, the Diego Garcia facility was completed Negotiations continue for Portugese building rights for site 5. Evaluation will be conducted on system enhancements such as addition of long wavelength infrared (LWIR) detectors, compensated imaging (visible) sensors and mobile GEODSS systems. In FY 1988, system enhancement evaluations will continue. These studies will include automated image processing, bistatic imaging system concepts and improved range resolution. These system enhancements will continue in FY 1989. Cost estimates are based on historic data and are thus Category I (Comprehensive). Although the program is a multi-contract effort, the largest portion is with Lincoln Laboratories, a Federal Contract Research Center (FCRC). This is a continuing program.

B. Project: 2296, Space Surveillance Network Improvement Program: This project provides the Research and Development (R&D) base for pre-planned improvements to the dedicated collateral and contributing radars. Developments in space object identification and mission assessment capability, and improve surveillance support for space defense. These sensors provide Refurbishment of the Pacific Barrier (PACBAR) III C-Band radar started in FY 1985 and will continue in FY 1988. In FY 1986, radar imaging improvement developments at Lincoln Laboratory/Haystack began. In addition, development will continue on providing a deep space real-time radar imaging capability at Lincoln Laboratory Haystack. This effort will serve as a prototype for potential future incorporation into other selected radar sites. The tactical communications upgrades to the Hawaiian Kaena Point C-Band radar begin as will the Haystack signal processing upgrade. In FY 1988, construction of the PACBAR III radar facility will begin. In FY 1988, an analysis program will continue to identify solutions for deficiencies identified in the Air Force Space Surveillance Architecture study. Alternative solutions include C-Band imaging radars for Kaena Point, Ascension Island and Antigua; and adding a deep space tracking capability to the SPACETRACK facility at Pirinclik. In FY 1989, the PACBAR III radar equipment for the Saipan site will begin installation as the construction phase is completed. Computer program integration and development and testing will begin. In FY 1989 we will initiate the Deep Space Surveillance Radar. Cost estimates are based on contractor estimates modified by the appropriate overhead and escalation factors. Considering the maturity of the program, this estimate is Category I (Comprehensive). This is a continuing program.

C. (U) Project: 3202, Air Force Maui Optical Station (AMOS): AMOS is a unique R&D facility for space surveillance and the development of electro-optical technology. As such, it supports critical DOD programs like space surveillance, antisatellite (ASAT) target assessment and the intelligence community. The support is provided through development programs, measurements programs and experimental programs. Satellite sensor evaluations are conducted to determine pointing references, to calibrate sensors, and to evaluate vulnerability and hardening studies. Satellite signatures are collected from a database and to evaluate satellite configuration changes. Programs like ASAT are dependent upon development in areas such as active atmospheric compensation, target acquisition, target discrimination and target assessment. A series of site upgrades took place in FY 1987 to make state-of-the-art technology available to support the FY 1988 and FY 1989 efforts. The upgrades included several major changes including a Laser Beam Director (LBD). In FY 1988, we will fund for the LBD to support the TEAL RUBY sensor calibration program and other recommended new lasers which will provide a source of real-time, line-of-sight, atmospheric parameters such as water vapor and aerosol concentration and temperature profiles unavailable elsewhere. Additionally, the Compensated Imaging System (CIS) has demonstrated its ability to significantly improve atmospherically distorted images of space objects. In FY 1988 and FY 1989, compensated imaging and infrared imaging technology development will continue. The satellite signature database will also be updated. The CIS project was formerly a Defense Advanced Research Projects Agency (DARPA) program and transitioned to the Air Force in FY 1985. Funding in FY 1987 is contained in Project 2296 of this program element. This is a continuing program.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102431F
DOD Mission Area:

Title: Defense Support Program (DSP)
Budget: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 112,399 | 88,462 | 84,132 | Continuing | N/A |
| 3624 | DSP | 112,399 | 88,462 | 84,132 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: DSP is the key element of the

The system consists of in geostationary orbital locations, two large processing station one Mobile Ground System (six Mobile Ground Terminals, six Mobile Communication Terminals, one Main Operating Base), one simplified processing station, one multi-purpose facility, and a ground communications network. The DSP provides the

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 113,022 | 103,807 | 95,214 | Continuing | N/A |
| MISSILE PROCUREMENT | 278,137 | 391,843 | 488,787 | Continuing | N/A |
| OTHER PROCUREMENT* | 116,608 | 31,458 | 5,679 | Continuing | N/A |

* Includes spares

EXPLANATION:

- (U) FY88 RDT&E decrease due to Congressional action.
- (U) FY89 RDT&E decrease due to general AF reduction.
- (U) FY87 missile procurement increased to cover costs associated with the delay in launch of flight 13.
- (U) FY89 missile procurement decrease due to general AF reduction.
- (U) FY87 other procurement decrease due to other AF requirements.
- (U) FY88 other procurement decrease due to change in sparing
- (U) FY89 other procurement decrease due to general AF reduction.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Funds | 273,637 | 391,843 | 432,832 | Continuing | N/A |
| Quantities (Satellites) | | 1 | 2 | | |
| Other Procurement: | | | | | |
| Funds | 107,683 | 24,885 | 6,194 | Continuing | N/A |
| Quantities | Not applicable | | | | |

5. RELATED ACTIVITIES: Defense Satellite Communications System (P.E. 0303110F and 0303605F) provides primary communications routing for DSP data and will help provide Mobile Ground System communications. Space Boosters (P.E. 0305119F) provides Titan 34D and Titan IV launch support. Space Launch Support Program (P.E. 0305171F) will provide Inertial Upper Stages and any Space Shuttle flights for DSP missions.

which will be the technical basis for the DSP Follow-on design pursued in this program.

6. WORK PERFORMED BY: Space Command and the Air Force Communications Command are the system operators and maintainers of the DSP ground stations. Air Force Systems Command's Space Division, Los Angeles Air Force Station, CA, has overall program management responsibility for development and acquisition. The Air Force Logistics Command, Wright-Patterson AFB, OH, provides engineering and logistics support. The Air Force Operational Test and Evaluation Center, Kirtland Air Force Base, NM, participates in test and evaluation of selected system segments. TRW, Redondo Beach, CA, is the prime contractor for the spacecraft and satellite integration. Aerojet Electrosystems Company, Azusa, CA, is the prime contractor for the infrared sensor, and the large processing station.

IBM, Boulder, CO, is the prime contractor for all software efforts as well as the prime contractor on the Mobile Ground System. The Aerospace Corporation, El Segundo, CA, furnishes general systems engineering and integration for the DSP System Program Office.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3624, Defense Support Program

A. Project Description: This is an operational program in which replacement satellites include evolutionary improvements for performance and survivability. These improvements have been incorporated on satellites 14 and beyond, which are designated DSP-I models. The first DSP-I will be delivered in FY 1988 and will be launched based on operational need. Projections indicate this will occur. The DSP-I is dual compatible, capable of launch by either the Titan IV or the Space Shuttle. Communications survivability will be improved by a satellite-to--satellite laser crosslink and by mission data message rebroadcast where the satellite transmits An autonomous station-keeping capability will add to satellite on-orbit endurance. Ground processing survivability has been obtained by deploying a Mobile Ground System (MGS) consisting of six Mobile Ground Terminals (MGTs), which process the raw satellite data into six Mobile Communication Terminals (MCTs), which provide the primary, hardened, jam resistant link to the users, and other support vehicles to sustain long-term operations in the field. The replacement of the computer peripherals in the ground stations will be continued, as well as upgrading to the operational software to make it compatible with the improved satellite capabilities. Orbital operations support, satellite maintenance and other efforts associated with maintaining a operational force structure will continue.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: Considerable effort was expended to build a prototype data control system to correct the Development and procurement continued for Mobile Ground Terminal hardware and software upgrades required for compatibility with the survivability enhancement of DSP-I. The Simplified Processing Station is also being made compatible with DSP-I. FY 1987 funds continue to support the Ground Communications Network upgrade which will relieve the current saturated condition and replace obsolete equipment.

(2) FY 1988 Program: DSP satellite The SED satellites incorporate the larger focal plane as used in the DSP-I satellites. A portion of the 1988 activity involves launch vehicle and upper stage integration This includes integration onto two launch vehicles (Shuttle and Titan IV) and one upper stage (Inertial Upper Stage) with DSP satellites. NASA and launch site support of integration are also included. Efforts will continue on the upgrades to the Mobile Ground System to make the processing and communications hardware compatible with DSP-I. Work will continue on revising the architecture of the ground station software.

Program Element: 0102431F
DOD Mission Area:

Title: Defense Support Program (DSP)
Budget Activity: 3 - Strategic Programs

This software redesign will fully complement the new capabilities of DSP-I (e.g. processing of data communicated through the laser crosslink and processing of new sensor data). The software redesign effort will make use of the DOD common programming language, Ada. This effort also includes redesign of the off-line analysis and support programs used to maintain the software. It also develops and prototypes changes in the secure satellite commanding system hardware and the spacecraft simulator to be compatible with the new DSP-I satellites. The spacecraft simulator is used to check out satellite commands before they are actually sent to the satellite. Funding also provides for general systems engineering and integration. The cost estimates were generated by the Program Office using comptroller prepared Independent Cost Estimates, contractor inputs, an OSD directed Independent Cost Analysis completed in July 1985, inputs from other government agencies and previous experience on similar modifications. Cost estimates are considered to be Category II - mature.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Assuming that present Shuttle and Titan IV launch plans hold firm, the Air Force will

Efforts will continue on the upgrades to the Mobile Ground System to make the processing and communication hardware and software compatible with DSP-I. Work will continue on revising the architecture of the ground station software. This software redesign will fully complement the new capabilities of DSP-I (e.g. processing of data communicated through the laser crosslink and processing of new sensor data) making use of the Ada programming language. This effort also includes redesign of the off-line analysis and support programs used to maintain the software. It also completes changes in the secure satellite commanding system hardware for the Mobile Ground System to be compatible with the new DSP-I satellites. Funding also provides for general systems engineering and integration. The cost estimates are generated by the Program Office using comptroller prepared Independent Cost Estimates, contractor inputs, an OSD directed Independent Cost Analysis completed in July 1985, inputs from other government agencies and previous experience on similar modifications. These cost estimates are considered to be Category II - mature.

(4) (U) Program to Completion: This is a continuing program. Primary emphasis will be directed toward eliminating or minimizing operational employment deficiencies and vulnerabilities, insuring a launch capability through the use of either the Titan IV or the Space Shuttle, the development of a survivable DSP system through the upgrades to the Mobile Ground System and satellites, and insuring the adequacy of the ground station data

Program Element: 0102431F
DOD Mission Area:

Title: Defense Support Program (DSP)
Budget Activity: 3 - Strategic Programs

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Initiation of Peripheral Upgrade | | August 1983 |
| (2) | | |
| (3) (U) First Mobile Ground Terminal Delivery | | August 1984 |
| (4) | | |
| (5) | | |
| (6) | | |
| (7) (U) Satellite #14 Delivery (First DSP-I) | *(3rd Qtr FY 88) | 4 Quarter FY 1988 |
| (8) (U) Successive Launches | | As Required |

*Date presented in FY 1988/FY1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(6)
(7) (U) Delivery slipped because of experimental sensor integration.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

Budget Activity: 3, Strategic Programs
Program Element: 0102431F, Defense Support Program (DSP)

Test and Evaluation Data

1. Development Test and Evaluation (DT&E): The Defense Support Program (DSP) was designed, developed, tested and then deployed as an operational system in the early 1970s. The system is a classified space program

information to the National Command Authorities and military commanders for decision-making purposes. Over the next several years, all system upgrades will require DT&E. These upgrades include the Peripheral Upgrade Program (PUP) and the DSP-I system upgrades.

The Sensor Evolutionary Development (SED) satellites have more infrared detection cells in the focal plane.

The sensor portion of the satellite is being produced by Aerojet ElectroSystems Company,

and the spacecraft is being produced and integrated by TRW, Incorporated.

(U) The purpose of the Mobile Ground System is to provide survivability to the Defense Support Program ground processing and communication elements through mobility. The prime contractor is IBM Corporation. DT&E was accomplished at the system level to ensure that the Mobile Ground System could meet its mobility and communication requirements.

(U) The Peripheral Upgrade Program (PUP) have replaced all peripheral equipment at the support sites and the operational large processing stations. Replacements provide processing and display capability for the DSP-I satellite improvements and preclude equipment obsolescence and non-supportability. The PUP contract was awarded to Aerojet ElectroSystems Company in September 1983. DT&E was completed in 1986 for the CONUS Ground Station, and will be completed in early 1988 for the Overseas Ground Station. The existing system must remain operational during the peripheral replacement and testing.

The DSP-I system includes satellite survivability upgrades: a satellite-to-satellite crosslink capability to reduce overseas ground station and communication vulnerablility, a mission data message rebroadcast capability to reduce communication vulnerability, and an autonomous ephemeris capability to allow the satellite to remain operational without regular updates from fixed ground stations. Development of the DSP-I satellites started in late fiscal year 1981. The first will be delivered in 1988. The DT&E program for these upgrades will include DT&E of the satellite, ground station hardware and software modifications.

2. (U) Operational Test and Evaluation (OT&E):

(U) Mobile Ground System (MGS). The Air Force Operational Test and Evaluation Center (AFOTEC) IOT&E of the DSP Mobile Ground System (MGS) started on 30 September 1985 and was completed on 31 March 1986. The field tests of the MGS consisted of multiple, 3 to 14 day deployments. Each deployment involved traveling to a pre-determined site, setting up, acquiring the satellite, and processing data for a given number of hours/days, then tearing down and relocating to another site. The deployed MGS convoys demonstrated the capability to operate with a high degree of mission success.

(U) Sensor Evolutionary Development (SED). The primary purpose of the SED system IOT&E is to ensure that the SED system meets the current operational mission capability without any degradation to the DSP mission. Testing was started for the AFSPACECOM-conducted, AFOTEC-monitored IOT&E when the SED satellite 6R was launched and the associated ground station were upgraded. Original timeframe for the SED IOT&E was April 1985 through November 1986. While the CONUS ground station (CGS) and the MGS have been tested, the complete IOT&E required the launch of satellite 5R. The delay in launching satellite 5R resulted in the testing at the simplfied processing station (SPS) and the overseas ground station (OGS) being put on hold. At the CGS, overall operational effectiveness and suitability were found to be satisfactory. Testing in the MGS was completed in Dec 87. The major finding was that the current MGS computers have insufficient memory for successfully performing Mission A. The IOT&E of the last two sites is scheduled for November 1988 (OGS) and March 1989 (SGS).

(U) Peripheral Upgrade Program (PUP). The PUP IOT&E is complete. In the three-phase test program, each phase corresponded to the testing at a specific site: the multipurpose facility (MPF), CGS, and OGS. The PUP upgrade improved the capability over the pre-PUP system. The test team is collecting the final suitability data for completing the IOT&E report.

(U) Survivable Defense Support Program (DSP-1). Test planning is in progress for the AFOTEC-conducted IOT&E of the survivable defense support program (DSP-1). The test approach, including description, schedule, locations, and resources, is being modified to reflect the latest requirements of the AFSPACECOM DSP system operational concept (SOC). The main elements to be tested in support of enhanced survivability for DSP are the laser crosslink subsystem (LCS) and the mobile ground system retrofit (MGS-R). The complete IOT&E of this system is divided into four phases: test the new subsystems on SAT-14; test first LCS on-orbit; test the full LCS with SAT-15 and SAT-16 on orbit; and then test the entire system with LCS & MGS. This phased approach enables AFOTEC to become involved as each satellite and ground support element becomes operational.

Budget Activity: 3, Strategic Programs
Program Element: 0102431F, Defense Support Program (DSP)

(U) The test tear (headed by AFOTEC) personnel requirements will be primarily obtained from AFSPACECOM resources. In addition, existing site operations personnel will be needed to support the test team during IOT&E activities at the fixed and mobile ground stations.

(U) HQ AFOTEC conducted an Early Operational Assessment (EOA) of the DSP-1 from Dec 84 - Jan 87 using the reports from contracted studies and simulations. The EOA showed that the subsystems and segments as specified should enhance the DSP survivability. A system level IOT&E should be conducted to ensure that all of the subsystems work together under the threat environment.

(U) Ground Communications Network (GCN) Upgrade: In early 1983, an AFSPACECOM steering committee reviewed the DSP GCN requirements and initiated a multiphase upgrade for FY85-89. The phases are the GCN port expansion (GCN PE), GCN PE Phase 1C which exercises an option to the GCN PE program, and GCN data entry and display (GCN DED). The GCN port expansion (GCN PE) project increased the number of high speed user data ports and added the advanced data communications control procedures message protocol capability. The majority of the GCN PE IOT&E was performed March through December 1985. The results of this portion were satisfactory. The final portion of the GCN PE, Phase 1C, will be tested in May 88. The GCN DED program will replace the old Sigma Computers at the Data Distribution Center with two new computers to function as the communication manager which distributes data from low speed sources to low speed users. The GCN DED also replaces the old user terminals with current technology terminals. The GCN DED IOT&E is an AFSPACECOM-conducted and AFOTEC-monitored effort.

(U) OT&E Reports Published:

(U) Mobile Ground System (MGS) IOT&E Final Report, June 1986,(S), HQ AFOTEC/TES.

(U) Survivable Defense Support Program (DSP-1) Early Operational Assessment Report, January 1987 (S) HQ AFOTEC/TE.

Budget Activity: 3, Strategic Programs
Program Element: 0102431F, Defense Support Program (DSP)

3. (U) System Characteristics:

| Characteristics | Objectives | Demonstrated |
|---|---|---|
| Current Operational System | | |
| Sensor Evolutionary Development | | TBD |

(U) DSP-I Improvements

| | |
|---|---|
| Satellite-to-satellite crosslink | Increased survivability |
| Mission data message rebroadcast capability | |
| Two color focal plane | |
| Autonomous ephemeris | |

Budget Activity: 3, Strategic Programs
Program Element: 0102431F, Defense Support Program (DSP)

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| (U) DSP-I IOT&E | Dec 84 - Sep 87 | Dec 84 - Oct 87 | Survivability studies and analysis phase of DSP-I testing continue. |
| (U) DSP-1 Early Operational Assessment (EOA). | Dec 84 - Nov 85 | Dec 84 - Jan 87 | Complete |
| (U) Peripheral Upgrade Program (PUP) IOT&E. | Apr 86 - Nov 86 | Apr 86 - Jan 88 | Complete |
| (U) Test and Evaluation Master Plan (TEMP) Approval | Jan 88 | See Remarks | At OSD for approval pending receipt of the Baseline Correlation Matrix expected 25 Jun 88. |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| (U) GS-14 IOT&E | Jul 88 - Jan 90 | Performed at CGS and OGS |
| (U) GCN PE PHASE 1C | May 88 - Jun 88 | |
| (U) GCN DED IOT&E | Sep 88 - Nov 88 | Cover all user locations |
| (U) SED OGS IOT&E | Nov 88 | IOT&E to take two weeks |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102432F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Sea Launched Ballistic Missile (SLBM) Radar Warning Systems
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 13,727 | 17,246 | 10,165 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The existing SLBM Radar Warning System consists of PAVE PAWS sites at Cape Cod AFS, MA, and Beale AFB, CA, Robins AFB, GA, Eldorado AFS, TX and the Perimeter Acquisition Radar Attack Characterization System radar in North Dakota.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 18,059 | 20,313 | 10,175 | Continuing | N/A |
| Other Procurement* | 99,402 | 2,079 | 767 | Continuing | N/A |

*Includes spares

EXPLANATION: (U) FY 1987 RDT&E reduction due to higher priority AF requirements.
(U) FY 1988 RDT&E reduction due to Congressional action.

Program Element: 0102432F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Sea Launched Ballistic Missile (SLBM) Radar Warning Systems
Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 99,512 | 5,593 | 1,769 | Continuing | N/A |
| Quantities | Not Applicable | | | | |

5. RELATED ACTIVITIES: The PAVE PAWS SLBM Early Warning System is part of the national system for Tactical Warning and Attack Assessment. It provides confirmation of initial launch detection information provided by the and complements the information provided by the Ballistic Missile Early Warning System (PE 0102423F) and SPACETRACK (PE 0102424F).

6. (U) WORK PERFORMED BY: The prime contractor is Raytheon Corporation, Wayland, MA. Major subcontractors are Control Data Corporation, Minneapolis, MN (hardware) and TRW, Redondo Beach, CA (software). The program is managed by Air Force Systems Command's, Electronic Systems Division, Hanscom AFB, MA, in conjunction with North American Aerospace Defense Command (NORAD), Space Command and Air Force Communications Command. General system engineering is being provided by Mitre Corporation, Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 12432F, SLBM Radar Warning Systems

A. Project Description: The Northeast (NE) and Northwest (NW) sites will undergo a computer upgrade to provide for commonality with the new Southeast (SE) and Southwest (SW) sites.

B. (U) Program Accomplishments And Future Efforts:

(1) (U) FY 1987 Accomplishments: On-site testing was completed and the SE site became operational in November 1986. On-site testing was completed and the SW site became operational in May 1987.

(2) (U) FY 1988 Program: New automated data processing (ADP) equipment is being acquired for the NE and NW sites to provide for system-wide commonality. System engineering software development and in-plant testing will be conducted in support of these system upgrades. Software development is also required to implement the ADP upgrade at the NE and NW sites which will result in system-wide hardware/software commonality. Cost estimates are Category I, Comprehensive.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: System engineering software development and in-plant testing will continue in support of the ADP upgrades for the NE and NW sites. On-site testing for the PAVE PAWS upgrade will continue through FY 1989.

(4) (U) Program to Completion: This is a continuing program; subsequent efforts will be implemented as necessary to accommodate evolving Tactical Warning/Attack Assessment needs.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Contract Award | | November 1983 |
| (2) (U) SE Site Initial Operational Capability (IOC) | | November 1986 |
| (3) (U) SW site IOC | | May 1987 |
| (4) (U) NE site computer upgrade complete | *(December 1989) | December 1990 |
| (5) (U) NW computer upgrade complete | *(March 1990) | March 1991 |

*Date presented in FY 1988/FY 1989 Descriptive Summary.

(U) Explanation of Milestone Changes:

(4) (U) Delay in procurement start because of extensive negotiations with the contractor.
(5) (U) Delay in procurement start because of extensive negotiations with the contractor.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102433F  Title: NUDET Detection System (NDS)
DOD Mission Area: 332-Strategic Surveillance and Warning  Budget Activity: 3-Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 23,212 | 7,369 | 10,922 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Strategic Air Command and Aerospace Defense Command require a highly survivable capability to detect, locate, and report any nuclear detonation (NUDET) on a global basis in near real time. The NUDET Detection System (NDS) consists of sensors on the operational Navstar Global Positioning System (GPS). NUDET information supports post-impact selection of appropriate retaliatory options in response to a nuclear attack against North America, as well as strike confirmation, and damage assessment. NUDET detection information is vital to the effective management of U.S. forces through the trans- and post-attack phases of a nuclear conflict. Reports to command centers of weapon effectiveness will be vital in managing strategic reserve forces and re-establishing a command structure. NDS data could be a major information component during negotiations to terminate a nuclear conflict.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 25,468 | 10,397 | 10,932 | Continuing | N/A |
| Missile Procurement | 9,338 | 11,900 | 0 | Continuing | N/A |
| Other Procurement | 2,798 | 13,891 | 13,960 | Continuing | N/A |

EXPLANATION: (U) The congressional reduction of $3 million RDT&E funding in FY 1988 delays, by one year, the integration engineering for the aircraft NDS terminal. FY 1989 Other Procurement funds were reduced to meet budgetary constraints; defers additional user terminal procurement until full production following IOT&E.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Missile Procurement | | | | | |
| Funds | 9,338 | 11,900 | 0 | Continuing | N/A |
| Quantities | 8 | 4 | 0 | | |

Program Element: 0102433F
DOD Mission Area: 332-Strategic Surveillance and Warning

Title: NUDET Detect System (NDS)
Budget Acticity: 3-Strategic Programs

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement (includes funding for initial spares) | | | | | |
| Funds | 2,798 | 14;170 | 0 | Continuing | N/A |
| Quantities | 0 | 2 | 0 | | |

5. RELATED ACTIVITIES: NDS sensors are flown on all Navstar Global Positioning System (GPS) satellites (PE 0305165F) beginning with the GPS launch in July 1983. Development and production of the X-ray and optical Nuclear Detection (NUDET) sensors for NDS are funded by the Department of Energy (DOE), The X-ray and optical sensors are integrated into the GPS satellite under PE 0301357F and PE 0305999F. Production of the airborne NDS terminals will be funded in the Worldwide Airborne Command Post PEs, 0101312F and 0302015F.

6. WORK PERFORMED BY: System development and procurement is accomplished by Air Force System Command's Space Division, Los Angeles AFB, CA Rockwell International, Seal Beach, CA, integrates the NDS sensors on GPS satellites and produces the Electromagnetic Pulse (EMP) sensor. Scientific Applications International Corporation, Manhattan Beach, CA, and the Aerospace Corporation, El Segundo, CA, provide systems engineering support. Sandia National Laboratories, Albuquerque, NM, and Los Alamos National Laboratory, Los Alamos, NM, are under contract to the Department of Energy (DOE) to produce the X-ray and optical nuclear detonation sensors. Texas Instruments, Dallas, TX, is developing and will produce the Ground/Airborne user terminals. E-Systems, Garland, TX, is developing the EMP receiver/processor for the satellite.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 12433F, NUDET Detection System

A. Project Description: The NDS payload consists of X-ray, optical, and electromagnetic pulse (EMP) sensors on the operational Navstar GPS constellation. These sensors, when coupled with the extremely precise GPS timing capability, will provide location of nuclear bursts worldwide This project develops and integrates the electromagnetic pulse sensor into the GPS satellite and develops the Ground/Airborne terminals to provide authorized users direct receipt of NDS nuclear detonation data. The data are also cross-linked to other GPS/NDS satellites which act as relay points. This cross-linking of information, when used with at least 18 satellites, will allow a user on one side of the earth to receive detonation data from the opposite side. It also provides multiple

redundancy of the data transmission for increased system availability and survivability. A broad range of users (National Command Authorities, Strategic Air Command, Aerospace Defense Command, other Unified and Specified Commands, will receive nuclear detonation (NUDET) data, direct from the spacecraft, on the precise location, yield, count, time, and height of burst.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Development and testing of the electromagnetic pulse (EMP) sensor was completed. NDS user terminal development continued. A user terminal antenna survey was conducted on a EC-135 PACER LINK II aircraft. Mission software tests were performed to reduce risks associated with terminal integration with ground fixed/mobile and airborne command posts. Engineering model tests to verify software/hardware integration continued.

(2) (U) FY 1988 Program: Integration efforts for the EMP sensor and NDS payload will continue on the GPS production spacecraft. The NDS user terminal development effort will continue. Procurement of user ground terminals for high priority users will be initiated. A NDS terminal reliability improvement program will begin.

(3) (U) FY 1989 Planned Program and Basis For FY 1989 RDT&E Request: Engineering development will begin on the NDS payload for the GPS replenishment satellites. Aircraft integration/modification activities will begin to support the Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) of the aircraft user terminal. A NDS development terminal will be installed at the Alternate Military Command Center in support of testing for the fixed configuration. Production activities will continue. The user terminal reliability program will continue. Costs for the NDS satellite sensor payload are based on previous NDS satellite sensor payload development efforts and are category II, mature, estimates. NDS user terminal development costs are based on similar terminal developments and contract costs, and are category II, mature, estimates. Last comprehensive review of the cost estimate was completed in July 1987.

(4) (U) Program to Completion: This is a continuing program. NDS sensor design and production are keyed to the GPS satellite schedule. The user terminal development program will conclude in early 1990 and NDS user terminal production will continue satisfying ground and airborne terminal users. Outyear RDT&E funds will support the development of fixes for deficiencies found during DT&E/IOT&E and required system operational improvements.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Defense Systems Acquisition Review Council II | June 1979 |
| (2) (U) Begin Satellite Production | August 1982 |
| (3) (U) Launch 1st NDS Equipped Global Positioning System Spacecraft | July 1983 |
| (4) (U) Launch 1st Operational Satellite | 1st Quarter FY 1989** |

| Milestones | Dates |
|---|---|
| (5) (U) Start User Terminal Initial Operational Test and Evaluation | *(1st Quarter FY 1989) 1st Quarter FY 1990 |
| (6) (U) Achieve Worldwide 2-Dimensional NUDET Location Capability | *(4th Quarter FY 1989) 3rd Quarter FY 1990** |
| (7) (U) Achieve Worldwide 3-Dimensional NUDET Location Capability | *(4th Quarter FY 1990) 1st Quarter FY 1991** |

* Date presented in the FY 1988/FY 1989 Descriptive Summary.
** Launch schedule dependent.

(U) Explanation of Milestone Changes

(5) (U) User terminal operational testing delayed due to slip in aircraft modification schedule resulting from the reduction of FY 1988 RDT&E funding.

(6) (7) (U) Operational capability achieved later due to changes in the GPS launch schedule.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/ FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0102436F
DOD Mission Area: 391 - Strategic Information Systems

Title: Command Center Processing and Display System
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 21,442 | 29,437 | 26,939 | Continuing | N/A |

2. ( ) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Strategic Air Command (SAC) Statement of Operational Need 1-80 identified the requirement to upgrade the current Command Center Processing and Display System (CCPDS). A CCPDS-Replacement (CCPDS-R) is necessary to correct current deficiencies and provide needed information for tactical warning. CCPDS-R consists of new computer hardware, software, display devices, and consoles for receipt and processing of ballistic missile Tactical Warning/Attack Assessment (TW/AA) information at the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) missile warning center and command post and the Headquarters SAC command post to enable the Commander-in-Chief (CINC) US Space Command (CINC-Space) and CINC-NORAD to provide tactical warning assessments to the National Command Authority (NCA) and enable CINC-SAC to protect US strategic forces. Common display of attack data will be provided to the NCA, CINC-NORAD, CINC-SAC, CINC-Space and other CINCs through the Attack Warning Processing and Display System (AWPDS) at the NORAD command post, SAC command post, National Military Command Center, Alternate National Military Command Center, and other command centers. CCPDS-R and AWPDS are essential to commanders and the NCA in making decisions related to nuclear force survival, execution of US strategic forces through and the use of strategic reserve forces during peacetime, preattack, and trans-attack phases of conflict. The AWPDS will also provide common TW/AA direct sensor data to survivable mobile command centers.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 25,699 | 32,052 | 38,064 | Continuing | N/A |
| Other Procurement | 2,052 | 3,124 | 27,491 | Continuing | N/A |

EXPLANATION: (U) FY 1987 actuals are lower than planned due to a one quarter delay in Full Scale Development contract award (Awarded June 1987). Funds were transferred to support faster development of Granite Sentry Program in PE 0102310F. The reduced FY 1988 RDT&E and Other Procurement funds result from the FY 1988 Congressional appropriation which will slip software development by three months, slip the SAC subset Preliminary Design Review into FY 1989, and add technical risk to operational testing. Programs in this Program Element (PE) and PE 0102310F were restructured in December 1987 to eliminate budget disconnects over the Five Year Defense Plan. The restructure plan required a transfer of $11,125K RDT&E funds for FY 1989 to PE12310F. AWPDS not funded until FY 1993. The reduced FY 1989 Other Procurement Budget estimate resulted from the program restructure and reflects reduced initial spares.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 996 | 1,119 | 24,966 | Continuing | N/A |
| Quantities | Not applicable | | | | |

5. (U) RELATED ACTIVITIES: PE 0102310F Ballistic Missile Tactical Warning/Attack Assessment (TW/AA) Support, funded development of the system operations concept, system hardware and software acquisition specifications, request for proposal, and the statement of work documentation during FY 1983. PE 0102310F, NCMC-TW/AA Systems, provides the major interface within the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) and the planned new Strategic Air Command (SAC) command posts by providing upgrades to other command control systems. Together PE 0102310F and PE 0102436F provide the core computer replacement systems which support the Joint Chiefs of Staff approved Integrated Tactical Warning and Assessment Architecture.

6. (U) WORK PERFORMED BY: The effort is managed by Air Force Systems Command's (AFSC) Electronic Systems Division (ESD), Hanscom AFB, MA. The Full Scale Development/Production contractor is TRW, Redondo Beach, CA. Systems engineering is conducted by Mitre Corporation, Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0102436F Command Center Processing and Display System (CCPDS)

A. (U) Project Description: The CCPDS-Replacement (CCPDS-R) is developing a replacement to the ballistic missile TW/AA command and control system at the NCMC and the SAC command post. At Offutt AFB, NE, CCPDS-R will be housed in the Offutt Processing and Correlation Center (OPCC) (Reference PE 0102310F) facility. CCPDS-R will enable the Commander-in-Chief (CINC) NORAD to provide the National Command Authority with TW/AA. CCPDS-R at Offutt AFB, NE will enable CINC-SAC to perform force management functions and protect US Strategic forces. CCPDS-R development will initially incorporate all the hardware and software capabilities necessary to satisfy the missile warning TW/AA requirements at the NCMC and OPCC. The second phase will complete the Headquarters SAC unique mission requirements to permit US strategic force management. The Attack Warning Processing and Display System (AWPDS) will follow these developments and, in coordination with other upgrades of the architecture (Reference PE 0102310F), will provide common displays of Integrated TW/AA data to all users. Eventually AWPDS will provide correlated missile, space, air defense, and intelligence information.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The Command Center Processing and Display System Replacement (CCPDS-R) Full-Scale Development/Production contractor was selected to design, develop, and test computer hardware and software. Computers, peripherals, and software was designed and developed for operations at the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) and Offutt AFB, NE. Testing of common computer programs, structured in a modular fashion for easy maintenance and modification, was begun. CCPDS-R completed a Major Automated Information Systems Review Council Milestone II review in June 1987 as required by OSD.

(2) (U) FY 1988 Program: Cheyenne Mountain Complex (CMC) will complete Preliminary Design Review (PDR). System testing will begin and initial operational test and evaluation will be conducted. Final software designs for Strategic Air Command (SAC) subset functions, will be completed. Development and definition of standard Integrated Tactical Warning and Attack Assessment displays for use by the National Command Authority and worldwide nuclear commanders will be initiated.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: CMC will complete Critical Design Review. SAC subset will complete PDR. Standard displays will be fully incorporated into the program. The FY 1989 CCPDS-R cost estimate is Category I, Comprehensive, based on priced contracts.

(4) (U) Program to Completion: This is a continuing program. The CCPDS-R upgrade of automated ballistic missile tactical warning and assessment functions at NCMC is scheduled for completion in FY 1992. The SAC subset effort will be completed during FY 1993. Program budgetary limitations and priorities of related programs will delay the Attack Warning Processing and Display System (AWPDS) research, development, test, and evaluation (RDT&E) development start until FY 1993.

C. (U) Major Milestones:

| | Milestones | | Dates |
|---|---|---|---|
| (1) | (U) SAC Statement of Operational Need (SON) 1-80 validated (CCPDS-R) | | May 1980 |
| (2) | (U) Design Definition Contract Award | | August 1985 |
| (3) | (U) Headquarters Air Force Space Command SON 10-85 validated (AWPDS) | | November 1986 |
| (4) | (U) CCPDS-R Full-Scale Development/Production Contract Award | *(March 1987) | June 1987 |
| (5) | (U) CCPDS-R Initial Operational Capability (IOC) | *(September 1990) | 4th Quarter FY 1992 |
| (6) | (U) CCPDS-R Full Operational Capability (FOC) | *(April 1992) | 4th Quarter FY 1993 |
| (7) | (U) AWPDS RDT&E Start | | FY 1993 |

*Date presented in FY 1988/FY1989 RDT&E Descriptive Summary

(U) Explanation of Milestone Changes:

(4) (U) Award delayed due to delay by OSD in Milestone II review by the Major Automated Information Systems Review Council.

(5) & (6) (U) Restucture of programs (See paragraph 3 "Explanation") delayed CCPDS-R IOC and FOC to eliminate budget disconnects over the Five Year Defense Plan. This action benefits the program by reducing development software risk.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303131F — Title: Minimum Essential Emergency Comm Network (MEECN)
DOD Mission Area: 331 - Strategic Command and Control — Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 56,619 | 50,402 | 41,033 | Continuing | N/A |
| 2832 | Very Low Frequency/Low Frequency (VLF/LF) Improvements | 31,336 | 38,144 | 22,021 | Continuing | N/A |
| 2834 | Ground Wave Emergency Network (GWEN) | 25,283 | 12,258 | 19,012 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element is the Air Force portion of a continuing program supporting the Chairman, Joint Chiefs of Staff, who is responsible for delivery of decisions of the National Command Authority in a precise and timely manner[ ] Current emphasis is on improved command, control and communications to improve survivability, endurability and performance under adverse nuclear and jamming conditions. MEECN VLF/LF improvements project consists of communication systems specifically designed[ ] The MEECN GWEN project provides a communications system specifically designed for command and control of strategic forces in pre- and early trans-attack phases of conflict. Communications in the VLF and LF region of the spectrum have attributes useful in strategic communications. These include low ambient propagation loss, significant penetration of sea water, and good performance in a nuclear disturbed environment.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 60,222 | 55,598 | 34,231 | Continuing | N/A |
| Aircraft Procurement | 0 | 0 | 40,116 | Continuing | N/A |
| Missile Procurement | 0 | 0 | 13,428 | Continuing | N/A |
| Other Procurement | 38,515 | 63,218 | 46,428 | Continuing | N/A |

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Program Element: 0303131F Title: Minimum Essential Emergency Comm Network (MEECN)
DOD Mission Area: 331 - Strategic Command and Control Budget Activity: 3 - Strategic Programs

EXPLANATION: (U) FY 1987 RDT&E decrease of $3,603 thousand due to programmatic reductions. FY 1988 decrease of $5,196 thousand for RDT&E was due to Congessional reductions. FY 1989 net increase of $6,802 thousand was due to a decrease of $1,000 thousand in VLF/LF Improvements project due to close-out of the Diversity Reception Equipment program and increase of $7,802 thousand in the Ground Wave Emergency Network (GWEN) due to a program restructure. FY 1988 Other Procurement reduction of $20,093 thousand was due to Congressional reductions and FY 1989 decrease of $41,034 thousand was due to budgetary reductions and resulted in a restructuring of the GWEN program. FY 1987 increase of $23,000 thousand in Aircraft Procurement for Miniature Receive Terminal (MRT) was due to aircraft program restructure. FY 1989 decrease of $12,600 thousand in Aircraft Procurement was due to deletion of GWEN modification on EC-135 Worldwide Command Post Aircraft which resulted from GWEN restructure. FY 1989 Missile Procurement reduction of $13,428 thousand was due to GWEN restructure.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) *These funds are for many various types of Minimum Essential Emergency Comm Network (MEECN) communications equipment within projects and therefore no quantities are indicated.

| | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement:* TOTAL | 23,000 | 0 | 27,516 | Continuing | N/A |
| PE 0303131F MEECN Project 2832 | 23,000 | 0 | 27,516 | Continuing | N/A |
| Other Procurement:* | | | | | |
| PE 0303131F MEECN Project 2834 | 38,581 | 43,125 | 5,394 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: Modifications to ground and airborne systems resulting from improvements developed under this program are funded in several program elements. PE 0101312F, Post Attack Command and Control System, previously contained funding for GWEN EC-135 aircraft modifications. PE 0101126F B-1B Squadrons, contains funding for Miniature Receive Terminal retrofit modification. PE 0101213F, Minuteman Squadrons previously contained funding for GWEN terminal integration into the Minuteman launch control centers. The Solid State Power Amplifier/Dual Trailing Wire Antenna (SSPA/DTWA) is a joint development with the Navy as lead service for a new higher power VLF/LF SSPA and DTWA system for the EC-135 Airborne Command Post Aircraft and the Navy Take Charge and Move Out (TACAMO) aircraft. A Memorandum of Agreement is maintained at the Assistant Secretaries of the Air Force and Navy level.

6. (U) WORK PERFORMED BY: Air Force Systems Command's Electronic Systems Division, located at Hanscom AFB, MA, has managerial responsibility for the Research, Development, Test and Evaluation, with support from the Rome Air Development Center, Griffiss AFB, NY, Air Force Logistics Command, Strategic Air Command, and other Air Force major commands. Naval Air Systems Command's Naval Airborne Strategic Communications, PMA 271, located in Wash DC, has the prime responsibility for the Solid State Power Amplifier/Dual Trailing Wiring Antenna program with support from the Naval Air Development Center, Warminster, PA; Naval Avionics Center, Indianapolis, IN; and Naval Air Test Center, Patuxent River, MD. Primary contractors are Analytical Systems Engineering Corporation, Burlington, MA (system engineering support); Mitre Corp., Bedford, MA (system engineering support); Spears Associates, Norwood, MA (horizontal polarized airborne receive antenna); Sonicraft, Incorporated, Chicago, IL (Diversity Reception Equipment); Rockwell International, Richards TX (Miniature Receive Terminal Solid State Power Amplifier/Dual Trailing Wire Antenna); RCA, Camden, NJ (Ground Wave Emergency Network); Logical Technical Services, Newark, New Jersey (Diversity Reception Equipment); Data Metrics, Chatworth, CA (Miniature Receive Terminal Printer); Dual and Associates, Arlington, VA (system engineering support).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2832, Very Low Frequency/Low Frequency (VLF/LF) Improvements

A. (U) Project Description: This project consists of improvements to our existing VLF/LF communications system to extend range, improve resistance to jamming and nuclear effects, and increase message accuracy at all ranges. The project includes adding VLF/LF receivers in B-1B and B-52H aircraft, and improving VLF/LF transmissions with a higher power transmitter and improved trailing wire antenna on EC-135 airborne command post aircraft. The project also provides Air Force support to JCS Minimum Essential Emergency Communications (MEECN) improvements requirements. The system improvements are based upon validation requirements of the Strategic Air Command and the other Single Integrated Operations Plan Commanders-in-Chief system deficiencies as reported by the Defense Communications Agency, and priorities of the Joint Chiefs of Staff.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The full scale development (FSD) of the Miniature Receive Terminal (MRT), Diversity Reception Equipment (DRE) MEECN Transmit Processor (MTP) and the Joint Navy/Air Force SSPA/DTWA programs continued. The MRT was flight tested on the B-1B and B-52H bombers. The DRE program continued with the fabrication of the engineering development models. The SSPA/DTWA will provide Air Force with a 100 Kilowatt (KW) SSPA replacing the existing 20 Kilowatt system.

(2) (U) FY 1988 Program: Development of the upgrades to our current Survivable Low Frequency Communication System (487L) continue. The Solid State Power Amplifier/Dual Trail Wire Antenna (SSPA/DTWA) FSD will continue with fabrication of the prototype units. FSD of Miniature Receive Terminal (MRT) depot support equipment begins. Flight

Program Element: 0303131F
DOD Mission Area: 331 - Strategic Command and Control

Title: Minimum Essential Emergency Comm Network (MEECN
Budget Activity: 3 - Strategic Programs

testing of the MRT on the B-1B and B-52H completes and production of the MRT on the B-1B aircraft begins. The Diversity Reception Equipment (DRE) program continues with fabrication and testing of the engineering development models.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: MRT B-1B production completes and MRT B-52H production begins. The FSD of SSPA/DTWA will continue and includes prototype testing and prototype installation into the aircraft. Funding also support continuing Air Force system engineering support to the Joint SSPA/DTWA development for which Navy is lead, continuing Air Force support to MEECN, and close-out of DRE program. Cost estimating category is II, mature, based on firm contractor prices.

(4) (U) Program to Completion: This is a continuing program. MRT production delivery will commence in FY 1990. SSPA/DTWA will complete FSD during FY 1990 and will begin Air Force production in FY 1990 leading to first Air Force production delivery and installation in FY 1991. MRT B-1B installation is expected to be completed during FY 1991.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) SSPA/DTWA | | |
| - Contract Award | *(January) | April 1987 |
| - Delivery of engineering development models | *(December 1988) | 2nd Qtr 1989 |
| - Air Force production decision | *(December 1989) | January 1990 |
| (2) (U) Diversity Reception Equipment (MEECN Transmit Processor) | | |
| - Phase I Full Scale Development Contract Award | | June 1982 |
| - Phase II Full Scale Development Contract Award | | May 1986 |
| - In-plant Development Test and Evaluation | *(July) | November 1988 |
| (3) (U) Miniature Receive Terminal (MRT) | | |
| - Validation Contract Award | | January 1983 |
| - Development Contract Award | | June 1985 |
| - Production Contract Award | *(NLT FY 1989) | June 1988 |
| - B-1B FOC | *(FY 1994) | April 1991 |

* Date presented in FY 88/89 Descriptive Summary

(U) Explanation of Milestone changes.

(1) (U) FSD Contract award delayed until April 1987 thus delaying subsequent milestones.
(2) (U) Field test eliminated by FY 1987 Congressional reductions and replaced with in-plant development.
(3) (U) Production start possible in FY 1988 due to program restructure.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2834, Ground Wave Emergency Network

A. (U) Project Description: This project defines, develops, tests, and deploys a proliferated ground wave communications system. This system provides U.S. strategic forces with the ability to maintain critical continental United States (CONUS) long-range command and control communications connectivity despite ionospheric disturbances caused by nuclear detonations. The network will handle low speed data messages (100 words per minute) for tactical warning, positive control launch of the bomber forces, and emergency action message dissemination to CONUS commanders, and bomber and tanker forces. The program was previously divided into three phases. Phase I is the Initial Connectivity Capability and was the concept validation phase. Phase II is the Thin Line Connectivity Capability and is the prototype network. In Phase III the network was to be expanded into a Final Operational Capability but Phase III has been restructured. Survivability for this system was provided primarily by proliferated relay nodes, using unmanned electromagnetic pulse (EMP) hardened, low-frequency, ground wave radio equipment. Strategic force commanders and units (equipped with EMP-hardened, secure radio equipment) interact with nearby relay nodes for participation in the network.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 was highlighted by several key accomplishment beginning with the successful completion and testing of the Thin Line Connectivity Capability (TLCC) system software. This allowed a smooth transition into the program's development, test, and evaluation (DT&E) phase. System design and relay node installation progressed at a rapid pace. Initial development of airborne command post terminals and the missile launch control center terminals progressed successfully. A programmatic Environmental Impact Statement (EIS) in support of the GWEN Final Operational Capability was successfully completed.

(2) (U) FY 1988 Program: The Air Force will begin Initial Operational Test and Evaluation (IOT&E) of the GWEN system in second quarter FY 1988 with a planned completion scheduled for third quarter FY 1988. Forty-nine relay nodes were installed by first quarter FY 1988. Following a production decision in third quarter FY 1988, the Air Force will then exercise a production option on the development contract for the production of the remaining relay nodes. The Air Force will award a development contract for the integration kits to be used with the airborne command post terminals. The Air Force will also award a development contract for a portable receive only terminal. Development of peculiar support equipment will begin and continue throughout the year.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of a new combined VLF/LF terminal for missile launch control centers will begin. A new Category IV cost estimate for this development effort was recently completed and reviewed in Nov 1987. This estimate assumes a competition for award of the development contract with production added as priced options to the develpment contract. Production, delivery, and installation of relay nodes procured in FY 1988 will continue through FY 1989 and will require funds for system engineering and program management support.

(4) (U) Program to Completion: To be determined.

C. (U) Major Milestones:

| | Milestones | Dates |
|---|---|---|
| (1) (U) | Initial Connectivity Capability (ICC) Contract Award | June 1982 |
| (2) (U) | ICC Test Complete | April 1984 |
| (3) (U) | TLCC | |
| | Design Contract Award | February 1983 |
| (4) (U) | TLCC Fabrication/Deployment Contract Award | October 1983 |
| (5) (U) | TLCC Development Completed | *(FY 1987) FY 1988 |
| (6) (U) | Initial Operational Capability (IOC) | *(FY 1987) FY 1989 |
| (7) (U) | Final Operational Capability (FOC) | *(FY 1996) TBD |

* Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes:

(5) (U) Thin Line Connectivity Capability development of the relay node equipment has slipped because of time required to correct hardware and software discrepancies and due to site acquisition delays.

(6) (U) Initial Operational Capability (IOC) has slipped due to slip in TLCC development completion, which will caused a resultant delay in start of Initial Operational Test and Evaluation.

(7) (U) Milestone date to be determined due to ongoing restructure of the GWEN program.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303152F
DOD Mission Area: 391 - Strategic Information Systems

Title: USAF WWMCCS Information System (AFWIS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 6,591 | 5,087 | 2,317 | Continuing | N/A |
| 3155 | USAF WWMCCS Information System | 6,591 | 5,087 | 2,317 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The existing Worldwide Military Command and Control System (WWMCCS) does not permit the various military commanders to support the National Command Authorities in a timely, accurate, or cost-effective manner. Inadequacies of the current system preclude the development of highly interactive, user-friendly, on line query and retrieval capabilities that are deemed requisite to support of command and control requirements. The WIS is the modernization program for the information collection, processing, and display system that includes WWMCCS Standard Automated Data Processing and related software systems, procedures, and supporting intra-site telecommunications. The Air Force WIS (AFWIS) program implements the Joint WIS program at Air Force WWMCCS sites and modernizes AF unique Command and Control Systems.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 7,592 | 5,107 | 5,319 | Continuing | N/A |
| Other Procurement | 8,100 | 25,719 | 34,810 | Continuing | N/A |

Explanation: (U) The FY 87 RDT&E was reduced due to the revised implementation schedule. The other procurement in FY 1988 was reduced due to Congressional action. The FY 1989 RDT&E and other procurement were reduced due to Department of Defense fiscal constraints and the revised acquisition schedule.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 8,100 | 0 | 10,000 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: RDT&E for joint hardware and software is being performed by the Joint Program Manager and funded under 0303154F, Worldwide Military Command and Control System (WWMCCS) Information System (WIS) Joint Program Management Office.

6. (U) WORK PERFORMED BY: Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. The Engineering and Integration contractor is GTE Systems, Billerica, Massachussetts.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3155, USAF WWMCCS Information System (WIS)

A. (U) Project Description: Air Force WIS (AFWIS) directs the modernization, integration, and implementation of the Joint WIS developed system at Air Force sites.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The integration contractor continued major site planning (integration and installation) activities. The integration contractor defined common Air Force command and control system interfaces to Joint WIS. The new AFWIS/Air Force Command and Control System (AFC2S) Program Management Directive (PMD) dated 20 Mar 87 realigned responsibilities between the AFWIS program office and the AFC2S program office.

(2) (U) FY 1988 Program: Site planning for all AF operational sites will be completed. Air Force Block B requirements will be identified and pre-installation tasks for Joint WIS Block B will be started. The cost estimates were updated by the AFWIS/SPO on 8 August 1986. Installation of Block A hardware will be completed at the Operational Test and Evaluation site (HQ Tactical Air Command, Langley AFB VA).

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Begin installation of WIS Block A hardware at the remaining Air Force operational sites. Pre-installation tasks for Joint WIS Block B equipment will be continued at other Air Force sites. Interface devices for both hardware and software will be installed at all operational sites. Definition of command and control at units below major command level will be developed. Installation of Transition Components at all sites is completed; Block A LAN installation continues.

(4) (U) Program to Completion: This is a continuing program. Systems engineering will be completed and interface units will be installed at sites. Software modernization will continue and Joint Mission and Air Force standard hardware installation will be completed at the remaining sites.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Air Force Worldwide Military Command and Control System (WWMCCS) Information System (AFWIS) Program Management Directive | * (August 1984) | March 1987 |
| (2) | (U) | Draft Air Force WIS (AFWIS) Baseline | * (December 1985) | January 1988 |
| (3) | (U) | Installation Design Support Contract Award | * (March 1986) | July 1987 |
| (4) | (U) | AFWIS First Site (Implementation of WIS Block A at AF lead site) | * (June 1987) | January 1988 |
| (5) | (U) | AFWIS Sites 2 thru 21 Begins | * (November 1987) | August 1989 |
| (6) | (U) | Transition Component Installation | | April 1989 |

* Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation Of Milestone Changes

(1) (U) New PMD realigned management responsibilities between AFCC and AFSC of AF-service and command unique program and AF installation of the joint program, respectively.
(2) (U) New baseline required by new PMD direction.
(3) (U) Followed slip in Joint WIS program.
(4) (U) Block A installation for AF lead site is delayed due to the delay in contract award of Joint WIS integration contract.
(5) (U) Implementation at AFWIS sites 2 through 21 were delayed to accommodate the revised schedule for Operational Test and Evaluation sites.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303154F
DoD Mission Area: 391 - Strategic Information Systems

Title: WWMCCS Information System (WIS) Joint Program Management Office (JPMO)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 94,928 | 21,406 | 66,363 | 412,261 | 713,758 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The WIS program was directed by the Deputy Secretary of Defense to modernize the data collection and processing (automatic data processing (ADP)) element of the Worldwide Military Command and Control System (WWMCCS) to provide command and control (C2) information for the National Command Authorities (NCA); support strategic and conventional planning and control of forces; provide an effective crisis action management system; support execution planning and monitoring; and provide supportability and sustainability of information for command and support of forces. The existing WWMCCS ADP initially acquired in the early 1970's has been periodically upgraded but continues to reply on a single vendor and outmoded software to support user needs. Reliance on a single vendor limits government opportunity to apply innovative technological solutions to improve support to the user and reduces avenues for lowering operations and maintenance costs. WIS will provide significantly improved C2 support for use by the NCA; the Joint Chiefs of Staff (JCS); unified, specified, and component commands; and other C2 organizations throughout the Department of Defense. WIS modernizes the WWMCCS Standard ADP software, hardware, and directly related telecommunications taking advantage of a modern software development and maintenance environment and state-of-the-art, commercial hardware and software to reduce life cycle costs. Key elements are modernization of the current WWMCCS hardware and software as described in the Joint Mission Element Need Statement, development of an automated message handling system (AMHS), and implementation of the Joint Operation Planning and Execution System to satisfy validated JCS required operational capabilities. The use of the Ada computer programming language is key to reduced life cycle software development and maintenance resource requirements.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousand)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 94,930 | 82,089 | 91,425 | 312,951 | 700,258 |

PE: 0303154F

Program Element: 0303154F
DoD Mission Area: 391 - Strategic Information Systems

Title: WWMCCS Information System (WIS) Joint Program Management Office (JPMO)
Budget Activity: 3 - Strategic Programs

EXPLANATION: (U) Reduction in FY 1988 RDT&E reflects congressional deletion of $60.6 million. Reduction in FY 1989 reflects deletion of $25.0 million due to FY 1988 congressional reductions that delay Block B Full-Scale Development (FSD). Increase in Additional to Completion and Total Estimated Cost reflects the impact of the FY 1988 cut with schedule delays and increased inflation.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 0303151F Worldwide Military Command and Control System (WWMCCS) Automatic Data Processing (ADP) funds the current WWMCCS ADP systems. PE 0303152F (WIS) funds Joint WIS procurement and Air Force standard software modernization which is closely coordinated with the WIS Joint Program Manager (JPM) effort. PEs 0303152A/N (WIS) fund Joint WIS procurement and unique Army and Navy modernization programs which are closely coordinated with the Joint WIS effort. Portions of 0303152A/N RDT&E resources, which partially funded the joint WIS effort from FY 1984 to FY 1987, were consolidated in 0303154F beginning in FY 1988. PEs 0303152K (WIS), 0303151H (WWMCCS ADP), and 0902498M (Management Headquarters (Admin)) fund Joint WIS procurement for Defense Communications Agency (DCA), Defense Nuclear Agency, and the Marine Corps, respectively.

6. (U) WORK PERFORMED BY: The WIS JPM is responsible for overall program management. Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA, is responsible for the engineering, development and acquisition of joint WIS. The primary contractors are GTE, Billerica, MA; IBM, Gaithersburg, MD; MITRE, McLean, VA/Bedford, MA; and RMS Technologies, Trevose, PA. Other contractor efforts in FY 1988 total $1.0 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0303154F, WWMCCS Information System Joint Program Management Office

A. (U) Project Description: WIS is in an evolutionary program which is modernizing the automated support for planning and execution of U.S. military operations. The program includes the transition from the old planning and support environment (WWMCCS Standard ADP), stressing modernization of software first, by utilizing the Ada computer programming language and modern data management tools. The government will manage and integrate the work of three primary contractors and a system support contractor. Capabilities will be tested, procured and deployed incrementally to preclude interruption to the command and control mission. The program is divided into three incremental blocks. The first increment, Block A, provides a much needed automated message handling facility, a local area network (LAN), and powerful desk-top workstations which multiply the effectiveness and timeliness of the operational staffs. The next

block fields the initial joint mission applications software and modernized hardware. This is the critical phase that replaces existing software systems for operational and deployment planning with improved automated support for joint planning and execution. It focuses on providing joint mission applications software to support deployment of military forces and execution of military operations under time-urgent conditions. The third block of WIS will bring significant new capabilities to the Unified and Specified Commands and Joint Staff for strategy determination, development of suitable military options, and identification/evaluation of courses of action to carry out military options. New and improved joint mission software capabilities to support mobilization, sustainment and employment are essential elements of this block.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: GTE completed critical design review and began development of the local area network hardware and software. AMHS user interface issues were resolved. Development testing of AMH components began. Installation of equipment to support operational test and evaluation (OT&E) of the first block of WIS capability began at U.S. Forces Command and the Defense Communications Agency operational test sites. Initial draft Block B System Specification and an initial Block B System Description were completed. A three-release concept for fielding Block B was selected, and draft system specifications and a System Design Review were completed for the first release. A prototype demonstration of the capabilities targeted for the first release was also completed and presented to the Unified Commands, Services, and Agencies, and the OJCS staff. The prototype demonstration was widely accepted by the using community and will serve as the basis for the detailed design and development of the Release 1 software.

(2) (U) FY 1988 Program: Installation of equipment to support OT&E began at U.S. Pacific Command in November 1987 and at Air Force Tactical Air Command in January 1988. Development, test and evaluation of Block A components (LAN, AMHS, Ada software development and maintenance environment and workstation will be conducted with initial subsystem testing at the Development and Evaluation Facility at Hanscom AFB, MA, and the WIS Operational Support Facility at Reston, VA. Design and development for Block B Release 1 will continue.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Early Operational Assessments of Block A hardware and software will be conducted at four sites (Air Force Tactical Air Command, U.S. Forces Command, U.S. Pacific Command, and Defense Communications Agency). Block A components will complete development, undergo development testing, system integration, and early operational testing. Block B will pass from concept validation and demonstration to full-scale development with a DAB Milestone II review. Design for Block B Release 1 will be completed and full-scale development will commence. The cost estimate used for Block A of WIS is a mature estimate (cost category II) updated in September 1987 and for Blocks B/C is a preliminary planning estimate (cost category IV). The last comprehensive review

of the estimate for Blocks B/C was made in December 1985. Independent cost analysis will be completed as succeeding increments of WIS pass through a Defense Acquisition Board (DAB) Milestone II decision.

(4) (U) Program to Completion: This program involves a continuous process of upgrade to the command and control hardware supporting NCA. Block A System IOT&E will be conducted and a deployment decision for AMHS will be made. The integration and common user contractors will continue preplanned AMHS and LAN deployment of Block A WIS to operational sites. Development test and evaluation of WIS capabilities will continue at the Development and Evaluation Facility. Full-scale development and operational testing of Block B Release 1 will be completed. Release 1 will be deployed to operational sites. Contracts will be awarded for a data base machine (Release 2) and a joint mission processing environment (Release 3). Specifications for planned enhancements to the Block A LAN and AMH will be completed (Release 3). Block B Release 3 capabilities will be developed and then deployed to the operational sites after Operational Test and Evaluation (OT&E). Initial definition of the follow-on software (Block C) to support mobilization, sustainment and employment missions will begin. Block C will complete its concept definition and enter full-scale development with the completion of a DAB Milestone II review. Development work will include efforts on advanced teleconferencing, simulation and analysis tools, further development of automated message handling capabilities and joint mission applications software, and development and fielding of software to support mobilization, sustainment and employment missions. OT&E on the succeeding capabilities developed for WIS will be conducted at operational test sites prior to operational deployment. WIS modernization program is expected to continue into the mid-1990's.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Joint Mission Element Need Statement Published | February 1982 |
| (2) (U) Report to Congress on Modernization of WIS | July 1982 |
| (3) (U) Joint Operation Planning and Execution System and Related Required Operational Capabilities (ROC) Received | July 1983 |
| (4) (U) Automated Message Handling (AMH) Multi-Command ROC Received | September 1983 |
| (5) (U) Integration Contract Award | October 1983 |
| (6) (U) Common User Contract Award | October 1984 |
| (7) (U) System Support Contract Award | July 1985 |
| (8) (U) Block A Defense Systems Acquisition Review Council I/II | July 1985 |

| | | | |
|---|---|---|---|
| (9) (U) | Block B DAB Milestone II | *(2nd Quarter FY 1988) | February 1989 |
| (10) (U) | Joint Mission Processing Environment Contract Award** | *(3rd Quarter FY 1988) | TBD |
| (11) (U) | Block A Operational Testing | *(1st Quarter FY 1989) | March 1989 - April 1990 |
| (12) (U) | Begin Initial Deployment of Block A | *(1st Quarter FY 1989) | November 1989 |
| (13) (U) | Deploy Block B | *(FY 1989 - FY 1991) | FY 1991 - FY 1994 |
| (14) (U) | Deploy Block C | *(FY 1990) | TBD |

*Date presented in FY 1988/1989 Descriptive Summary
**Previously titled Joint Mission Hardware Contract Award

(U) Explanation of Milestone Changes

(9) (U) Decision to prototype Block B Release 1 on the current WWMCCS hardware and funding reductions delay the deployment of Block B software and the Block B DAB Milestone II to February 1989.

(10) (U) Decision to prototype Block B Release 1 on the current WWMCCS hardware and funding reductions delay the acquisition of JMPE.

(11) (U) Operational testing will consist of a series of Early Operational Assessments and concluding with a full Block A System IOT&E. Block A Initial Operational Test & Evaluation was deferred due to linkage of procurement to test results. IOT&E date is currently targeted for April 1990.

(12) (U) Block A deployment was deferred due to linkage of deployment to test completion. Deployment to be accomplished incrementally. LAN will be deployed after successful completion of LAN operational assessment and AMHS after successful completion of Block A IOT&E.

(13) (U) Block B deployment is being revised to support incremental deployment of discrete Block B capabilities prior to full Block B deployment in FY 1994 due to congressional funding reductions and to accommodate Department of Defense budget constraints.

(14) (U) Block C deployment milestone planning is being revised due to prior year funding reductions and to accommodate Department of Defense budget constraints.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): DT&E on the Worldwide Military Command and Control System (WWMCCS) Information System (WIS) will be conducted according to the Test and Evaluation Master Plan (TEMP) which was approved by the Office of the Secretary of Defense after a Defense Systems Acquisition Review Council milestone I/II review of Block A in July 1985. An updated TEMP is expected to be approved in March 1988. The TEMP provides a description of the DT&E for each of the WIS subsystems. The WIS Test Planning Working Group (TPWG) has developed a Baseline Correlation Matrix that provides traceability of user requirements through the operational test and evaluation program.

(U) The WIS is an evolutionary program. As each of its subsystems is developed, it will pass through component/subsystem DT&E, system DT&E, Integrated Systems Test, and Initial Operational Test and Evaluation (IOT&E). As each subsystem passes through the latter stages of testing, as well as during its deployment, user feedback will be documented and, together with new user-defined requirements and new technology, will be used to plan and develop major enhancements. The enhanced elements will then pass through the same phases of testing. This iterative process will continue for the life of WIS and make its T&E an ongoing process.

(U) WIS is being implemented in a block approach which permits the system evolution to be divided into manageable portions. The subsystems of Block A which require developmental effort are the Local Area Network (LAN) and the Automated Message Handling (AMH) capability. The LAN subsystem DT&E began in January 1987 and will continue through May 1988. The AMH began subsystem DT&E in October 1986 and will continue through CAT III testing which will end in October 1989. The first phase of Block A system DT&E will be completed in January 1990. No DT&E reports have been issued.

(U) An Integrated Systems Test (IST) at the Defense Communications Agency's (DCA) Operational Support Facility (OSF) starts at the completion of the first phase of LAN system DT&E and ensures that changes to the current WWMCCS automatic data processing operating system software and the WIS Block A capabilities are properly integrated. This testing will be planned and conducted by DCA. The IST will be performed from October 1988 to February 1989.

(U) The second phase of LAN system DT&E will be an operationally oriented system test utilizing user personnel in an actual operational environment. The purpose of the second phase is to ensure readiness for the LAN Early Operational Assessment. This test will be conducted at the Development and Evaluation Facility at Electronic Systems Division and at the actual operational test sites from December 1988 to February 1989.

(U) The WIS Joint Program Manager directs the Joint WIS program and tasks engineering development and acquisition activities to the WIS System Program Office (SPO). The Director, WIS

SPO, Electronic Systems Division, chairs the Test Planning Working Group (TPWG) and is responsible for the management of all DT&E activities. DT&E will be conducted at the Development and Evaluation Facility with the assistance of the WIS Integration Contractor and associate contractors, which are developing portions of the system. The facility was developed and is operated by the WIS SPO. The Integration Contract was awarded to GTE, the Common User Contract was awarded to IBM, and a Systems Support Contract was awarded to RMS Technologies. Additional contracts for hardware and software will be awarded later in the program.

2. (U) Operational Test and Evaluation: There has been no OT&E conducted on WIS. Initial Operational Test and Evaluation (IOT&E) is scheduled for April to May 1990. IOT&E will be conducted at the Operational Support Facility (OSF) in Reston, Virginia, and at operational test sites for Air Force at HQ TAC, Army at HQ FORSCOM, and Navy at HQ USCINCPAC. The OT&E will consist of exercises conducted by the four sites, with the OSF configured as the National Military Command Center. Functional users from the test sites and test scenarios based on OJCS exercises will be used to ensure a realistic test environment. Operational testing will satisfy the operational critical issues of mission utility, responsiveness, interoperability, security, operations in a degraded mode, availability, responsiveness flexibility, and software supportability.

(U) Responsible OT&E agencies. HQ AFOTEC is the lead operational test agency for the WIS multiservice OT&E. Supporting OT&E agencies are COMOPTEVFOR for Navy, and OTEA for Army. OJCS/J6I is representing the OJCS in the OT&E planning.

(U) Reports. None.

3. (U) System Characteristics: The WIS key operational and technical performance requirements are based upon the Joint Chiefs of Staff approved Joint Operation Planning and Execution System, the National Military Command System Information System, and the Automated Message Handling Multi-command Required Operational Capabilities (MROCs). These requirements were analyzed and yielded the following WIS Block A objectives and thresholds (approved at the July 1985 Defense Systems Acquisition Review Council):

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Response Time | | |
| Simple (priority) | 8 - 10 Seconds | No tests conducted |
| Complex (priority) | 2 - 4 Minutes | |
| Security | System High (Highest Level of Classification) | |
| Usability | 20 Hours of Training | |
| Interoperability | Automatic Digital Network (AUTODIN), Defense Data Network (DDN) | |

Budget Activity: 3, Strategic Programs
Program Element: 0303154F, WWMCCS Information System (WIS) Joint Program Management Office

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Availability | 95% | No Tests conducted |
| Crisis | 98% | |
| Mean Time Between Failure (Workstation/Printer) | 1500 Hours | |
| Diagnostics (Automated Message Handling Processor) | 90% Fault Detection Rate | |
| Software Portability | Multiple Workstation Use | |
| Hardware Portability | Multiple Vendor Workstations Accessible on the Local Area Network | |
| Peak Messages Received/Day | 2000 | |
| Peak Messages Received/Hr | 300 | |
| Peak Messages Transmitted/Hr | 100 | |

NOTE: Blocks B and C of WIS will add capabilities and will be defined in detail as the program progresses.

4. (U) Current Test and Evaluation. No operational test and evaluation under this program element has been done in the WIS program for the past 12 months.

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| Automated Message Handling Subsystem DT&E | June 1986- June 1987 | October 1986- October 1989 | In progress. DT&E efforts were delayed because of the need to redefine user interface. |
| Local Area Network Subsystem DT&E | January 1987- November 1987 | January 1987- May 1988 | In progress. DT&E efforts delayed because of software development problems. |

Budget Activity: 3, Strategic Programs
Program Element: 0303154F, WWMCCS Information System (WIS) Joint Program Management Office

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Automated Message Handling Subsystem DT&E | January 1987- October 1989 | DT&E efforts were delayed because of the need to redefine user interface. |
| Block A System DT&E (Phase I) | November 1989- January 1990 | The development of the AMH has been decoupled from the LAN development. |
| Integrated Systems Test (IST) for LAN | October 1988- February 1989 | Begins at completion of Phase I LAN DT&E. Ensures new capabilities are properly integrated with existing ADP system. |
| Submission of DCP and TEMP revision | March 1988 (DCP) October 1988 (projected for TEMP delivery) | Submitted for update and approval of restructured program. |

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303601F  Title: Milstar Satellite Communications System (AF Terminals)
DoD Mission Area: 333 - Strategic Communications  Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 258,562 | 198,226 | 310,347 | Continuing | N/A |
| 2487 | Milstar(AF Terminals) | 258,562 | 198,226 | 310,347 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and acquires Air Force Satellite Communications (AFSATCOM) Ultra High Frequency terminal modifications, transponder test set upgrades, and gap filler AFSATCOM payloads, required for transition to the Milstar satellite system. It also provides resources for development/ acquisition of Milstar Extremely High Frequency terminals for the Air Force. The Milstar satellite system will provide a highly survivable, jam-resistant, worldwide, secure communications system to support the President and the military Commanders-in-Chief for command and control of selected United States strategic and tactical forces in all levels of conflict.

3. (U) COMPARISON 'ITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 271,968 | 229,229 | 310,353 | Continuing | N/A |
| Aircraft Procurement | 0 | 2,900 | 21,673 | Continuing | N/A |
| Other Procurement | 725 | 129 | 59,681 | Continuing | N/A |

EXPLANATION: (U) FY88 RDT&E reductions Congressionally mandated. Procurement increases implements FY88 Appropriation Conference language accelerating Milstar program.

4. (U) **OTHER APPROPRIATION FUNDS: ($ in thousands)**

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| **Aircraft Procurement** | | | | | |
| Funds | 0 | 0 | 21,673 | Continuing | N/A |
| Quantities (terminals) | | | 2 | | |
| **Other Procurement** | | | | | |
| Funds | 725 | 129 | 77,099 | Continuing | N/A |
| Quantities (terminals) | 0 | 0 | 4 | | |
| **Military Construction** | | | | | |
| Funds | 0 | 0 | 4,000 | Continuing | N/A |

5. (U) **RELATED ACTIVITIES:** Missile Procurement funding in FY 1991 and following procures additional Ultra High Frequency (UHF) transponders on classified host spacecraft to maintain the current Air Force Satellite Communications (AFSATCOM) UHF capability. Procurement and installation of transition upgrades to airborne AFSATCOM terminals to allow UHF compatibility with the Milstar system are funded within the modification line of each weapon system Program Element (PE). Approved transition users include the following PE's: PE 0101113F, B-52 Squadrons; PE 0101115F, B-1B; PE 0101213F, Minuteman Squadrons; PE 0101312F, Post Attack Command and Control System/World Wide Airborne Command Post (EC-135); PE 0208019F, Tactical Cryptologic Activities (RC-135); and PE 0302015F, National Emergency Airborne Command Post/E-4B Class V Mods. PE 0303603F, Milstar Satellite Communications System (Space and Mission Control), will develop and acquire the spacecraft and mission control segments for this highly survivable, jam-resistant, worldwide command and control communications system.

6. (U) **WORK PERFORMED BY:** Selected terminal modifications for transition of the AFSATCOM system to Milstar are being developed and produced by Rockwell International, Santa Ana, CA, and Linkabit Corp, La Jolla, CA. Remaining AFSATCOM terminal modifications and the Air Force Milstar EHF terminals are being developed by the Raytheon Company, Sudbury, MA., teamed with Rockwell Collins of Cedar Rapids, IA. and Bell Aeospace of Buffalo, NY. Federal Contract Research Center support is provided by the MITRE Corporation, Bedford, MA, and Lincoln Laboratory, Lexington, MA.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:** Not Applicable.

Program Element: 0303601F
DoD Mission Area 333 - Strategic Communications

Title: Milstar Satellite Communications System (AF Terminals)
Budget Activity: 3 - Strategic Programs

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: #2487, Milstar Satellite Communications System (AF Terminals)

A. (U) Project Description: The upgrade of Air Force Satellite Communications (AFSATCOM) to Milstar involves both command post and force element terminals and is being executed in multiple steps to maintain strategic connectivity during the transition. Command post terminals in EC-135 aircraft and at selected ground locations will be upgraded to the Milstar Ultra High Frequency (UHF) modulation compatibility in FY 1989-FY 1990 to allow immediate use of the on-orbit Single Channel Transponders and early use of Milstar satellites. These same terminals plus mobile command posts and satellite mission control elements will be upgraded to full Extremely High Frequency (EHF)/UHF capability. Nine EC-135C command post aircraft are planned to receive early EHF/UHF Engineering Development Model allowing an early EHF injection capability (EHF uplink, UHF downlink) into the first Milstar satellites. The remaining command posts (EC-135H/J/P, E-4B, E-6) will receive full capability starting in FY 1992. Force element terminals will receive the UHF Dual Modem Upgrade starting in FY 1987 and it is expected that at least 450 force element aircraft (B-52, B-1B, EC135A/G, RC135, etc.) will have Milstar UHF capability prior to launch of the first satellite. Finally, force elements will be upgraded to EHF by the mid 1990's providing full jam and scintillation resistant communications capability.

B. (U) Program Accomplishments and Future Efforts:

(U) (1) FY 1987 Accomplishments: Installation of Milstar upgrades to command post and force element AFSATCOM terminals continued. Field Development Test and Evaluation of the UHF transition command post terminal was completed. Fabrication and integration of three qualification model EHF-EHF/UHF terminals was completed and qualification and reliability tests performed. Began in-plant developmental testing and evaluation of EHF terminals using the Fleet Satellite (FLTSAT) Communications System EHF transponder package successfully placed into orbit on FLTSAT 7 on 4 December 1986. The upgrade of AFSATCOM host vehicle transponder test equipment began. Additional high inclination AFSATCOM transponders are required in the mid-1990's to maintain strategic connectivity if existing assets survive only to their predicted design life. The existing AFSATCOM transponder design must be upgraded to replace components no longer available. Upgrading the test equipment allows design and test of a new UHF transponder for host satellites and provides an enhanced capability for testing transponders already on orbit. Requirements definition and architecture for a Low Volume EHF Terminal (LVT) was completed. The LVT design goal for aircraft is 300 pounds as compared with 800 pounds for the standard Milstar EHF terminal. The goal for ground LVT's is 200 pounds with a very limited capability 50 pound terminal possible. These

miniaturized terminals will meet requirements for National Command Authority, advanced aircraft, special forces, and classified survivable communications.

(2) (U) FY 1988 Program: Begin development of the upgraded Air Force Satellite Communications (AFSATCOM) transponder by the host program office. Begin technology insertion development for the LVT. Continue installation of force element and command post Ultra High Frequency (UHF) radio upgrades to permit fast frequency hopping will begin. The installation of UHF upgrades in force element aircraft and ground terminals as well as production of UHF transition terminals for command posts. Prototype standard terminals will be tested against EHF transponders aboard Navy Fleet Satellites to support a Low Rate Initial Production (LRIP) decision. Most RDT&E funds will be applied to the fabrication and deployment of Engineering Development Model (EDM) terminals for EC-135C aircraft and selected ground sites. These EDM terminals will provide an early capability for very jam resistant cross band operation (Extremely High Frequency (EHF) uplink and UHF downlink) with force element terminals. Additional RDT&E will be applied to fabrication and assembly of advanced antennas subsystems for Peacekeeper missile systems currently in the design phase. An Independent Cost Assessment for the core standard terminal program was performed and the results presented to the Office of the Secretary of Defense Cost Analysis Improvement Group on 1 February 1985. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the core standard terminal program is Category I, Comprehensive.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Funding of AFSATCOM transponder development will continue. Begin design of the LVT. Development of special antennas for advanced aircraft and non-standard ground applications will continue. Begin installation of command post UHF upgrades. The Initial Operating Capability for the improved AFSATCOM UHF Single Channel Transponder Injection System will be reached. Production and installation of EDM EHF terminals will continue. Perform "turn key" installation at Offutt AFB. LRIP of EHF terminals will begin for planned installation beginning in FY 1991. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the standard EHF and EHF/UHF terminal development program is Category I, Comprehensive.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Milstar Terminal Full Scale Development (FSD) Start | September 1983 |
| (2) (U) Extremely High Frequency (EHF) Preliminary Design Review | June 1984 |
| (3) (U) EHF Terminal Critical Design Review | February 1985 |
| (4) (U) Phase II FSD Contract Award | May 1985 |
| (5) (U) Start of EHF Terminal Qualification Model Integration | August 1986 |
| (6) (U) Milstar Low Rate Initial Production Start | FY 1989 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 0303601F, Milstar Satellite Communications System (Air Force Terminals)

AS OF: February 1988

**Test and Evaluation Data**

1. (U) Development Test and Evaluation (DT&E):

(U) Test Schedule

| | |
|---|---|
| (U) Air Force Satellite Communications System (AFSATCOM) Upgrade Testing | FY86/87 |
| (U) In-plant DT&E: | FY86/88 |
| - Brassboard/Prototype Testing | FY86/87 |
| - On Orbit Transponder Tests | FY88 |
| - Reliability/Growth Tests | FY89 |
| ( Field DT&E/Initial Operational Test & Evaluation (IOT&E) | [ ] |

(U) AFSATCOM Terminal Dual Modem/ARC-171 Upgrade - To prevent loss of communications during transition from the existing AFSATCOM Ultra High Frequency (UHF) communications system and the new Milstar Extremely High Frequency (EHF) system, existing AFSATCOM terminals are being upgraded to be compatible with the limited UHF capability on the Milstar satellite and jam resistant modes on Single Channel Transponders now present on a variety of host spacecraft. The modifications involve replacement of several circuit boards in existing AFSATCOM modulator-demodulator (MODEM) units and minor ARC-171 radio modifications. Backward compatibility to AFSATCOM is maintained. Most developmental testing of the Dual Modem and ARC-171 radio modifications has been completed and there are no significant discrepancies.

(U) Milstar Terminals - The Air Force awarded a contract for the second phase (post Critical Design Review) of terminal Full Scale Development to the Raytheon Company, Sudbury, Massachusetts in June 1985. Major subcontractors include the Rockwell International, Advanced Communication & Countermeasures Division of Santa Anna, California and Bell Aerospace Textron of Buffalo, New York. The Air Force Milstar Terminal Program Office at Electronic Systems Division has formed a Terminal Test Planning Working Group to coordinate test issues. Detailed test plans arrived to support the February 1985 Critical Design Review. In-plant developmental testing will be accomplished with factory test equipment and complimented by the Milstar Design Verification Model and satellite test sets. Field level testing will begin first with the FLTSAT Extremely High Frequency packages and later with the Milstar satellites.

2. (U) Operational Test and Evaluation (OT&E): (See also Program Element 33603F Milstar Satellite Communications Program.)

Budget Activity: 3, Strategic Programs
Program Element: 0303601F, Milstar Satellite Communications System (Air Force Terminals)

(U) The Milstar Air Force Terminal Initial Operational Test and Evaluation (IOT&E), managed by the Air Force Operational Test and Evaluation Center (AFOTEC), performs operational assessments supporting Low Rate Initial Production and full scale production decision. Also, the Air Force terminal will be reevaluated from an overall system perspective during Milstar Multiservice IOT&E. In addition to the future efforts described above, AFOTEC conducted an IOT&E(1) on the Air Force terminal which was completed in November 1985.

(U) IOT&E(1) results were published in the Milstar Air Force Terminal IOT&E(1) final report dated November 1985. The primary purpose of the IOT&E(1) was to identify and report any problem areas, risks, and shortcomings of the Milstar Air Force terminal program in fulfilling user operational requirements. IOT&E(1) was accomplished by review of program documentation and participation in key meetings, design reviews, and source selection. In the November 1985 final report, AFOTEC listed five concerns which have since been resolved.

(1) (U) Software security measures being used by contractors during development of the AF terminal software were inadequate. However, the terminal program office, working with the Computer Resources Working Group, strengthened security procedures. Under the new program, terminal software is developed in a vaulted area, extensive software reviews have been instituted, access to the software is strictly controlled, and the contractor has been trained and is fully supportive of software security procedures.

(2) (U) Logistics Support Analysis (LSA) was not being accomplished correctly by contractors. The program office has updated and verified the LSA "A" sheet to reflect more accurate estimates. The update is on revision "G" and is an iterative cycle.

(3) (U) Terminal diagnostic design was inadequate to assure complete fault detection/fault isolation of terminal failures. This problem has been resolved and there is now a fully integrated approach with extensive Built-In-Test at the terminal level as well as Modular Automated Test Equipment (MATE) at the Intermediate and Depot maintenance levels. Compatible software design within the terminal and MATE system will reduce non-reproduceable errors.

(5) (U) AFOTEC reported that the threat to Milstar was not baselined into Milstar system specifications and that threat documentation did not address the total threat. A new, more detailed Milstar System Threat Assessment Report (STAR) is in process and currently in Defense Intelligence Agency coordination. The new assessment addresses the total system and will permit the specifications to be properly updated, if required.

(U) The operational assessment to support the LRIP will be based on monitoring in-plant DT&E testing, review of DT&E test results, a combined DT&E/OT&E terminal interoperability demonstration, participation in the LSA process, and some limited OT&E analysis in the survivability area. The purpose of the assessment is to estimate the terminal's operational effectiveness a d suitability in meeting operational requirements. Test assets will include in-plant engineering development model terminals, the prototype FLEETSATCOM EHF Package (FEP) at MIT Linclon Laboratory, the on-orbit FEP, and the development verification model (DVM) Milstar communications payload at TRW, Redondo Beach, CA. The in-plant DT&E tests which will be monitored include terminal contact item box level testing, terminal prime item performance testing, and system integration testing with the prototype FEP, and the Milstar DVM. Interoperability between AF terminal and the Army and Navy terminals will be assessed via an interoperability demonstration that will be conducted as a combined DT&E/OT&E effort. The assessment will conclude fall 1988 and will support a LRIP decision which is planned for November 1988.

(U) The AF terminal OT&E will involve both combined DT&E/OT&E and dedicated IOT&E. The combined DT&E/OT&E will be conducted in conjunction with the terminal developer Air Force Electronic Systems Division (ESD) and will involve monitoring field DT&E of three terminal configurations communicating first with the on-orbit FEP and then finally with on-orbit Milstar. Preceding the full scale production decision, AFOTEC will conduct a dedicated IOT&E of the terminal. The dedicated IOT&E will involve evaluating the operational effectiveness and suitability of the terminal against operational thresholds. The dedicated test will be conducted in a representative operational environmental using several production representative terminals communicating with an on-orbit Milstar satellite. Interoperability between the AF terminal and the Army and Navy terminals will be evaluated by setting up representative networks between the three terminal types through the on-orbit Milstar satellite. This testing will be conducted by an Air Force test team which will be initially formed in FY88 and fully staffed by FY90.

Budget Activity: 3. Strategic Programs
Program Element: 0303601F, Milstar Satellite Communications System (Air Force Terminals)

3. ( System Characteristics:

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| EHF Max Data Rate (kilo-bits/sec) | | To be demonstrated |
| Bit Error Rate (EHF fully processed) | | To be demonstrated |
| Bit Error Rate (EHF partially processed) | | To be demonstrated |
| Bit Error Rate (Ultra High Frequency) | | To be demonstrated |
| Anti-Jam Protection, degradation in deci-bells of Energy-Per-Bit/Noise-Energy for specialized jamming (pulse, chirp, partial band tone, partial band noise.) at $10^{-5}$ decoded bit-error rate. | | To be demonstrated |
| Terminal Mission Availability (12 hour mission) | .96 | To be demonstrated |

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual/Predicted Date | Remarks |
|---|---|---|---|
| Complete LRIP Test Approach | Jun 87 | Jun 87 | Approved by DOT&E Jun 87 |
| Begin LRIP Assessment | Jul 87 | Jul 87 | None |
| Form LRIP Cadre | Jul 87 | Jul 87 | Two Officers Placed at ESD |
| Test Program Outline | Dec 87 | Jan 88 | None |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Finalize LRIP Test Plan | Feb 88 | None |
| Complete OT&E Test Approach | May 88 | None |
| Test Plan Outline (TPO) Revision | Jun 88 | None |
| Activate OT&E Test Cadre | Oct 88 | None |
| Test Plan Outline (TPO) Revision | Dec 88 | None |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

1. RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 456,605 | | | Continuing | N/A |
| 2932 | Milstar | 456,605 | | | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Milstar Satellite Communications System program is a joint service program to develop and acquire the Milstar Extremely High Frequency (EHF) satellite, its mission control segment, and new or modified communications terminals. The Milstar system will provide a highly survivable, jam-resistant, world-wide, secure communications system to meet the minimum essential wartime communications needs of the President and Commanders-in-Chief to command and control selected Air Force strategic and tactical forces through all levels of conflict. It will also support other high priority users in crisis/contingency situations. This Program Element funds for development of the Milstar satellite and its associated Mission Control Elements (MCE).

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 470,316 | 366,095 | 257,322 | Continuing | N/A |

EXPLANATION: (U) FY 1987 - Assessment for Congressional undistributed reductions. FY 1988 - Congressional action to accelerate out year satellite acquisition and launch schedule as discussed in the classified annex to the FY 1988 Congressional conference report. FY 1989 - Increase required to comply with FY 88 Congressional language.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Air Force has total system development responsibility, heads the Joint Milstar Program Office and manages the development and acquisition of the space and mission control segments. Each Service manages a terminal program (Air Force for airborne and selected ground, Navy for shipborne and selected ground, and Army for ground) under the orchestration of the Milstar Joint Terminal Program Office managed by the Navy (PE 0303603N).

Program Element: 0303603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

The Milstar program was initiated in FY 1982 with funds in the Space Communications program (PE 0603431F) and Air Force Satellite Communications System (AFSATCOM) (PE 0303601F). The Milstar Satellite Communications System (PE 0303603F) was created in the FY 1983 President's Budget submission and contained both satellite and terminal development funds. However, beginning in FY 1984, Air Force Extremely High Frequency (EHF) terminal development is funded in Milstar Satellite Communications System (Air Force Terminals) (PE 0303601F), formerly AFSATCOM, and the Milstar satellite and Mission Control Element (MCE) development is funded in Milstar Satellite Communications System (Space and Mission Control) (PE 0303603F). This is consistent with all other DOD Satellite Communications (SATCOM) development and production programs. In addition to developing the new Milstar satellite, the Air Force is also managing the development and acquisition of the EHF applique packages for Fleet Satellite Communications vehicles F-7 and F-8 which are funded in the Navy's EHF SATCOM (PE 0604577N). The Army and Navy terminals are funded under Satellite Communications Ground Environment (PE 0303142A) and EHF SATCOM (PE 0604577N and 0303109N) respectively. Air Force Ground Mobile Forces (GMF) terminals are being funded under Satellite Communications Terminals (PE 0303605F). Development of Titan IVs to provide assured access to space for Milstar is funded in Space Boosters (PE 0305119F).

6. (U) WORK PERFORMED BY: The development of the Milstar satellite and the MCE for the Milstar system is managed by Air Force Systems Command's Space Division, Los Angeles AFB, CA. The contract for Full Scale Development of the Milstar satellite and MCE was awarded on 30 June 1983. The prime contractor is Lockheed Missiles & Space Co., Sunnyvale, CA. Subcontractors to Lockheed include: Hughes Aircraft Co., El Segundo, CA (crosslink and frequency and time standards subsystems); TRW, Inc., Redondo Beach, CA (payload subsystem); General Electric Co., Valley Forge, PA (data handling subsystem); and Ford Aerospace Communications Corporation, Palo Alto, CA (crosslink receivers). The Aerospace Corporation, El Segundo, CA, provides general system engineering and integration.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: #2932, Milstar Satellite Communications System (Space and Mission Control)

A. Project Description: This program designs, fabricates, tests, and acquires the Milstar EHF satellite consisting of the mainframe (or "bus"), the communications payload, antenna suite and the MCE. The system will incorporate state-of-the-art techniques for jam-resistance and survivability. Key features include higher frequencies, bandspreading, on-board signal processing, end-to-end encryption, hardening, [ ] a high degree of autonomy and on-orbit storage. A special endurance feature of Milstar is the MCE which will allow selected command terminals located on survivable platforms to control the satellite/system. An Ultra High Frequency (UHF) package will provide backward compatibility with existing UHF systems and facilitate the transition to EHF. This program will provide world-wide, two-way, jam-resistant, secure, highly survivable and enduring communications capability.

Program Element: 0303603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The primary effort was the fabrication and testing of the DFS-1 and its communications payload. Long lead parts acquisition for DFS-3 continued, and the fabrication option was exercised. Fabrication of DFS-1 and DFS-2 continued. The system level Critical Design Review (CDR) for the space segment and subsystem level CDRs for the mission control segment were conducted. Major emphasis was placed on integration of the satellite with the Centaur Upper Stage and then integration of the spacecraft and Centaur with the Titan IV. Development of system level end-to-end test plans were completed and initial system level testing began. Preliminary planning for Initial Operational Test and Evaluation (IOT&E) of the Mission Control Element (MCE) began on ground mobile platforms.

(2) (U) FY 1988 Program: The basic program includes completion of the final bus assembly for DFS-1, initial integration of the payload onto the spacecraft, continued fabrication of DFS-2 and DFS-3. Option to purchase long lead parts for DFS-4 will be exercised. Compatibility testing between communications payload and Service terminals will be conducted. The system level CDR will be conducted for the MCE. IOT&E planning for the MCE will continue, and platform design work will be conducted for future installation of engineering development model MCEs. Launch system integration of the Milstar spacecraft with the Titan IV will continue. An Independent Cost Analysis (ICA) will be completed on the space and mission control portions of the program.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: DFS-1 hardware and software integration will continue. Bus and payload integration will continue. Qualification testing and system level acceptance testing will continue. Fabrication of DFS-2 and DFS-3, and long lead parts acquisition for DFS-4 will continue. The fabrication option for DFS-4 will be exercised to comply with FY 88 Congressional direction to accelerate program. Cost estimates are mature, Category II and based on current contract awards, an update to the ICA for the satellite and MCE completed in November 1984, a Single Best Estimate for the satellite and MCE completed in November 1986, and the ICA completed in March 1988.

(4) Program to Completion: This is a continuing program. Development work will continue on the satellite and MCE with launch of DFS-1 scheduled for early [ ] (Developmental satellites two through five will be launched by [ ]) All satellites will be launched solely using Titan IVs and Centaur Upper Stages. Satellite production, commencing with satellite number six, is scheduled to begin in FY 1992. Installation of engineering development model MCEs will begin in FY 1990. Installation of production MCEs will begin in FY 1994.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Program Start | April 1981 |
| (2) (U) Start Concept Validation Phase | March 1982 |

C. (U) **Major Milestones:** (continued)

| | | | | |
|---|---|---|---|---|
| (3) | (U) | Full Scale Development Contract | | June 1983 |
| (4) | (U) | Satellite Payload Preliminary Design Review (PDR) | | July 1984 |
| (5) | (U) | Satellite System PDR | | November 1985 |
| (6) | (U) | Start Fabrication of Developmental Flight Satellite #1 (DFS-1) | | September 1986 |
| (7) | (U) | Satellite System Critical Design Review (CDR) | *(FY 1987) | July 1987 |
| (8) | ( ) | Delivery of satellite to launch facility | [ ] | [ ] |
| (9) | ( ) | Launch of DFS-1 | | |
| (10) | ( ) | Initial Operational Capability | | |
| (11) | ( ) | Full Operational Capability | | |

* Date presented in FY 1988/89 Descriptive Summary.

(U) **Explanation of Milestone Changes**

(7) (U) Satellite CDR completed in July 1987.

(8 & 9) (U) Delivery and launch of satellite slipped because of necessity for simultaneous availability of satellite, terminals, booster and pad.

9. (U) **COOPERATIVE AGREEMENTS:** Not Applicable.

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Full Scale Development contract for the Space and Mission Control Segments was awarded in FY 83 and DT&E has started.

(U) Test Schedule

( ) Satellite and Mission Control Element (MCE) Part/Circuit/Box Level Survivability Tests

( ) Interface Tests - Payload to Terminal
- MCE to Satellite
- MCE to Air Force Terminal

( ) System Level End-to-End Tests (Performance, Survivability, Interoperability)

( ) On-Orbit DT&E Tests

(U) In December 1986, Navy Fleet Satellite F-7 was launched carrying the first Fleet Satellite Communications (FLTSATCOM) Extremely High Frequency (EHF) Package (FEP). The FEP is a scaled down version of the Milstar EHF payload. Following satellite checkout, the FEP payload commanding, telemetry, and communications signal processing using the FEP earth coverage and spot beam was successfully checked out by an Air Force/Navy/Lincoln Lab team.

(U) Field testing on the Navy terminal began in May 1987 using a destroyer, submarine, and shore station with the on-orbit FEP and the Navy satellite simulator. Major test objectives accomplished included evaluation of antenna pointing, baseband interfaces, network protocols, anti-jam/low probability of intercept, submarine dual band antenna integration, and platform integration.

(U) The Air Force Ultra High Frequency (UHF) transition terminal and Milstar UHF payload subsystem uplink and downlink waveform compatibility was successfully demonstrated. An Air Force Full Scale Development (FSD) Airborne Command Post (ABNCP) terminal was successfully tested with the prototype FEP located at Lincoln Lab. Demonstrated functions included uplink/downlink acquisition, network protocols, network setup, and voice communications using the Advanced Narrowband Digital Voice Terminal (ANDVT).

(U) Milstar is a joint service program with participation by all services. The Air Force has been designated Executive Agent for Milstar. The Joint Milstar Program Office provides overall management of the Milstar program and

is located at Air Force Systems Command's Space Division in Los Angeles, CA. The Space and Mission Control Segments of the Milstar program are managed from Space Division. The Terminal Segment efforts are orchestrated by the Joint Terminal Program Office (JTPO) which is a part of the Navy's Space and Naval Warfare Systems Command in Washington, DC (Program Element [PE] 0303603N). The JTPO provides guidance and system engineering support to each service terminal program office. The Air Force terminal program office is located at Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA. The Air Force terminal program is discussed in the Test and Evaluation Data Sheet for PE 0303601F, Milstar Satellite Communications System (Air Force Terminals). The Navy terminal program office is located at Space and Naval Warfare Systems Command's Navy Extremely High Frequency (EHF) Satellite Communications Terminal Program Office, Washington, DC. The Navy Milstar terminal effort is contained in PE 0604577N and PE 0303109N. The Army terminal program office is located in Communications-Electronics Command's Single Channel Objective Tactical Terminal Project Office, Fort Monmouth, NJ. The Army Milstar terminal effort is contained in PE 0303142A. Space Division is responsible for Developmental Test and Evaluation (DT&E) of the Space and Mission Control Segments of the Milstar system. The responsible agency for the Space and Mission Control Segments Initial Operational Test and Evaluation (IOT&E) is the Air Force Operational Test and Evaluation Center (AFOTEC). Air Force Space Command is designated the system operator and will be responsible for operation of the Milstar satellite constellation as well as Mission Control Segment. Air Force Logistics Command will be responsible for the Mission Control Segment maintenance.

(U) Lockheed Missiles and Space Company, Sunnyvale, CA, is under contract to Space Division for the general systems engineering and the Space and Mission Control Segments. The Air Force airborne and ground communications terminals are being developed by Raytheon in Sudbury, MA. The Navy's seaborne terminals are being developed by Raytheon in Sudbury, MA. The Army terminals are being developed by Magnavox, Ashburn, VA.

2. (U) Operational Test and Evaluation (OT&E):

(U) Responsible Organizations: Two IOT&E activities will be funded under this program element. First, AFOTEC will conduct an IOT&E of the Milstar Mission Control Segment. Second, a multiservice IOT&E of the overall system will be conducted. AFOTEC has been designated the lead agency for conducting this multiservice IOT&E program. AFOTEC, the Army Operational Test and Evaluation Agency (OTEA), and the Navy Commander, Operational Test and Evaluation Force (COMOPTEVFOR), will participate in the multiservice IOT&E which will take place as a combined Development Test and Evaluation (DT&E)/OT&E effort. A multiservice test team will be formed with representatives from Air Force, Army, Navy, and the Defense Nuclear Agency (DNA) to conduct the IOT&E testing.

(U) Mission Control Element (MCE) OT&E. AFOTEC will conduct OT&E of the MCE. The OT&E will consist of an operational assessment to support a planned Low Rate Initial Production (LRIP) decision and dedicated OT&E to support the full scale production decision. The operational assessment will involve monitoring both in-plant and field DT&E testing. The assessment will estimate the MCE's capability to satisfy operational requirements. Following the assessment, AFOTEC will conduct dedicated OT&E to evaluate the MCE's operational effectiveness and suitability against operational thresholds. The dedicated OT&E will involve field test of three production representative MCEs controlling the first on-orbit Milstar satellite. The three MCEs will be in representative operational environments on fixed and ground mobile platforms and will be operated and maintained by military personnel.

Budget Activity: 3, Strategic Programs
Program Element: 3360[illegible] Milstar Satellite Communications System (Space and Mission Control)

(U) Multiservice Operational Test and Evaluation (OT&E). Air Force Operational Test and Evaluation Center (AFOTEC), (the lead Service), Army Operational Test and Evaluation Agency (OTEA), and Navy Commander, Operational Test and Evaluation Force (COMOPTEVFOR) will jointly plan the multiservice Initial OT&E (IOT&E) which will take place as dedicated IOT&E. This IOT&E will be conducted by a multiservice test team directed by an Air Force O-6 (Colonel) and be comprised of Air Force, Army, and Navy test teams. The multiservice OT&E will evaluate the overall Milstar system from the perspective of its capability to satisfy end-to-end mission communications requirements. Testing will be conducted on a representative system consisting of the first two and then three on-orbit Milstar satellites; Air Force, Army, and Navy terminals; and an operational mission control segment including constellation control stations and the Milstar Master Control Center (MMCC). The overall approach to evaluating communications performance will be to establish and test communications networks which are as representative as possible of networks required in the Joint Milstar Communications and Control Operations Concept, the Milstar joint requirements document. The network testing will evaluate terminal interoperability (terminals of all three Services) and system connectivity, including satellite crosslink connectivity, in realistic network communications scenarios. Mission control will be evaluated in terms of its capability to support satellite constellation health and welfare and to operate the overall system in a manner that supports operational mission requirements. Each Service will prepare and staff independent evaluation reports. In addition, the Services will prepare and staff a joint report consolidating the findings of all three Services.

3. (U) System Characteristics:

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| (U) Survivability | | |
| ( ) Jam Resistant | | Future Tests |
| ( ) Low Probability of Intercept | | Future Tests |
| ( ) Nuclear Scintillation | | Future Tests |
| (U) Performance | | |
| ( ) Capacity | | Future Tests |
| ( ) Constellation Time Control | | |
| ( ) Constellation Ephemeris Control | | Future Tests |
| (U) Mission Control Element (MCE) Mean Time Before Failure | 600 hours | Future Demonstration |

Budget Activity: 3, Strategic Programs
Program Element: 0303603F, Milstar Satellite Communications System (Space and Mission Control)

4. ( Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| Mission Control Element: | | | |
| | | | Continuing Program |
| | | | Continuing Program |
| Satellite: | | | |
| | | | Continuing Program |
| | | | Continuing Program |
| | | | Continuing Program |
| Mission Control Element T&E | | | |
| Identify OT&E Platforms | FY 87 | FY 88 | |
| Complete Test Program Outline (TPO) | FY 88 | FY 88 | |
| Multiservice T&E | | | |
| Brief Multiservice Test Approach | FY 88 | FY 88 | Briefed OSD DOT&E |
| Complete Multiservice Test and Evaluation Master Plan (TEMP) | FY 87 | FY 88 | Currently in coordination with Services |



(440)

Budget Activity: 3, Strategic Programs
Program Element: 0303603F, Milstar Satellite Communications System (Space and Mission Control)

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Mission Control Element | | |
| Satellite | | |
| Mission Control Element | | |
| T&E | | |
| Complete Test Approach | FY 89 | |
| Revise TPO | FY 88 | |
| Revise TPO | FY 89 | |
| Multiservice T&E | | |
| Complete TPO Outline | FY 89 | |
| Complete multiservice test approach | FY 89 | |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0401123F
DOD Mission Area: 265 - Intratheater Airlift

Title: Military Airlift Group (IF)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 8,664 | 9,952 | 193 | 0 | 37,342 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force One Replacement Program is designed to replace the existing Air Force One aircraft (Boeing 707 models) which are 15 and 25 years old, respectively. They are becoming increasingly difficult to maintain and support as the number of Boeing 707s in commercial airline service worldwide is declining and is expected to approach zero by 1990. In addition, the existing aircraft do not meet Federal Aviation Administration noise standards and require improvements in communications equipment, range, performance, and payload. The present aircraft are space limited and cannot accommodate present or future requirements. These requirements include adequate work/rest space for the President, his staff and the aircrew, and an emergency treatment medical facility. In an effort to reduce ground support requirements, the replacement aircraft will include self-contained steps, automated baggage loading equipment and auxiliary power units capable of operating all onboard equipment and maintaining a comfortable environment while the aircraft is on the ground. After a competitive source selection, the Secretary of the Air Force chose the B-747-200B as the winner of the competition. A maintenance and support complex is being built at Andrews AFB MD to support the two new aircraft.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 8,664 | 12,415 | 192 | 0 | 39,804 |
| Aircraft Procurement | 0 | 0 | 0 | 0 | 306,180 |

EXPLANATION: (U) The differences in the "FY 1988 Estimate," "FY 1989 Estimate," and "Total Estimated Cost" columns can be attributed to the Congressional action which reduced the FY 1988 RDT&E account by $2,424 million and to an "in house" reduction of $39 thousand in FY 1988 and "in house" addition of $1 thousand to FY 1989. In order to bring program funding back up to the level necessary to complete the ongoing RDT&E effort and deliver Air Force One on time, the Air Force must reprogram $1.529 million into the FY 1988 RDT&E account. Aircraft procurement differences can be attributed to a $7,100 million requirement for initial spares that was funded from FY 1986 spares appropriations in accordance with Congressional direction.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Military Construction: Funds | 25,000 | 20,000 | 0 | 0 | 45,000 |

5. (U) RELATED ACTIVITIES: The Air Force has contracted with E-Systems to upgrade the communication systems of six aircraft in the Special Air Mission fleet at Andrews AFB, MD. This program is known as the mid-term upgrade of the Mission Communication System (MCS). Under this contract, E-Systems will develop a switch to function as the heart of the MCS and will provide six ship sets designed for installation in the narrow-body aircraft at Andrews. The mid-term upgrade of the MCS system is considered to be the baseline communications system for the replacement aircraft. E-Systems will modify two of these six ship sets for installation into the replacement wide-body Air Force One aircraft.

6. (U) WORK PERFORMED BY: Air Force Systems Command's System Program Office at Aeronautical Systems Division, Wright-Patterson Air Force Base OH. The prime contractor for the replacement aircraft is the Boeing Military Airplane Company, Wichita, KS.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: PE 0401123F, Air Force One Replacement Program

A. (U) Project Description: This project replaces the primary and backup Presidential aircraft with two new B-747-200B aircraft. These off-the-shelf aircraft will require extensive redesign for interior accommodations, self-contained steps, electromagnetic pulse (EMP) hardening and the communications suite. In addition, the aircraft will require both EMP (component-level) testing and flight testing.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Finalized aircraft interior design concept and continued the design and integration effort for the interior accommodations, communications system, avionics equipment and EMP hardening of the flight controls and the mission essential communications equipment. FY 1987 RDT&E funds were used to redesign the B-747-200B airframe and its propulsion and avionics systems, as well as for MCS design and configuration, aircraft interior, EMP hardening, systems test and evaluation, systems engineering and program management, mission support and other government costs.

(2) (U) FY 1988 Program: Continue the design and integration effort for the interior accommodations, communication system, and avionics equipment and perform systems-level testing of the EMP-hardened communications system, avionics, and flight controls to ensure that we have the proper levels of protection. We will also flight test the aircraft to include antenna installation, pattern and flutter testing, electromagnetic interference/compatibility, infrared suppression, and smoke and fume elimination due to the unique aircraft interior. In addition, we must certify the Category III microwave landing system, the electronic flight instrument and navigation systems, and perform engine qualification testing. RDT&E costs also include funds for mission support, overhead engineering and laboratory support.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Final RDT&E funding increment which will be used for the development of the global positioning system (GPS) and the infrared countermeasure (IRCM) system for the Air Force One replacement aircraft. Program considered Confidence Level II, Mature.

(4) (U) Program to Completion: RDT&E funds are not required beyond FY 1989.

C. (U) Major Milestones:

| | Milestones | Dates |
|---|---|---|
| (1) (U) | Received Program Co-Ahead | 15 August 1985 |
| (2) (U) | Awarded Architect-Engineer Contract for Maintenance and Support Complex | 8 May 1986 |
| (3) (U) | Awarded Aircraft Acquisition/Contractor Logistics Support Contracts | 7 July/16 July 1986 |
| (4) (U) | Awarded Construction Contract for Maintenance and Support Complex | 14 April 1987 |
| (5) (U) | Aircraft #1 Rolled Off Production Line/Entered Modification Phase | 16 April/13 May 1987 |
| (6) (U) | Aircraft #2 Rolled Off Production Line/Began FAA Certification | 13 July/29 October 1987 |
| (7) (U) | Deliver Aircraft #1/#2 Mission Communication System Kits | 4 January 1988/16 May 1988 |
| (8) (U) | Aircraft #2 Enters Modification Phase | 28 April 1988 |
| (9) (U) | Complete Maintenance and Support Complex | 19 October 1988 |
| (10) (U) | Complete Qualification Test and Evaluation/Qualification Operational Test and Evaluation | 14 November 1988 |
| (11) (U) | FAA Conformity Inspection | 16 November 1988 |
| (12) (U) | Deliver Aircraft #1 | 30 November 1988 |
| (13) (U) | Deliver Aircraft #2 | 31 May 1989 |

8. (U) PROJECT OVER $10 MILLION FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603230F
DOD Mission Area: 221 - Counterair

Title: Advanced Tactical Fighter (ATF)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 260,000* | 498,054 | 702,283 | 1,318,416 | 3,075,186* |
| 2472 | Advanced Tactical Fighter | 61,035 | 95,300 | 182,495 | 528,716 | 882,438 |
| 2878 | Advanced Tactical Fighter Engine | 160,081 | 339,254 | 410,788 | 384,693 | 1,557,736 |
| 2995 | Critical Subsystems Development | 38,884 | 63,500 | 109,000 | 405,007 | 635,012 |

* Does not reflect $34,099 reprogramming action.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The ATF program will develop the next generation air superiority fighter for introduction in the mid-1990s to counter the emergence of large numbers of advanced Soviet fighters. The ATF is being designed to penetrate enemy airspace and achieve a first-look, first-kill capability against multiple targets. Program emphasis from the outset has been balanced on affordability, reliability and maintainability, performance, and survivability. To develop and mature the advanced concepts and technologies required in this next-generation fighter prior to its entering Full-Scale Development, hardware demonstrations and risk reduction efforts will be accomplished in a 50-month Demonstration/Validation (Prototype) phase. The Demonstration/Validation phase has been structured to incorporate the fabrication and demonstration of a ground-based prototype avionics integration laboratory and construction and flight testing of prototype air vehicle designs.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 248,821 | 536,826 | 702,995 | 1,318,416 | 3,104,166 |

EXPLANATION: (U) FY 1987 change was a restoration to the appropriation level. FY 1988 change was primarily a Congressional reduction during the appropriation process. FY 1989 was adjusted for changes in inflation factors and across-the-board RDT&E adjustments. The differences in the total estimated costs are the net result of funding adjustments for budgeting refinement from FY 1986 through FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

PE#: 0603230F



(445)

5. (U) RELATED ACTIVITIES: The Advanced Tactical Fighter (ATF) program is related to the Advanced Fighter Technology Integration (AFTI) program (PE 0603205F and PE 0603245F) which will develop technology for integrated avionics suites, digital flight controls, and aerodynamic refinements to meet the need of the next generation fighters. The AFTI program is currently flight testing an F-16 with a highly integrated flight/fire control system to demonstrate greater capability and survivability in unguided weapons delivery and air-to-air combat. Using an F-15, the AFTI program will also demonstrate an advanced two-dimensional thrust vectoring/reversing engine nozzle and integrated flight and propulsion controls for enhanced maneuvering performance and effective short takeoff and landing capability. The Integrated Electronics Warfare System/Integrated Communication, Navigation, Identification (CNI) Avionics program (PE 0603109F) will exploit a number of recent innovations in systems architecture, Very High Speed Integrated Circuit semiconductor technology, computerization, and computer software to integrate and automate avionics functions for the ATF. Preliminary Full-Scale Development (FSD) for INEWS and ICNIA (PE 0604250F) will perform those development activities necessary to assure Integrated CNI, Electronic Combat and Communications Security (COMSEC) equipment will be available for the ATF avionics aircraft for ATF FSD. Engineering development for the ATF training systems is funded in PE 0604227F, Flight Simulator Development. After the Milestone II FSD decision in FY 1991, ATF development efforts will be funded in PE 0604239F, ATF Engineering. Initial long lead procurement will be funded in PE 0207219F, ATF.

6. (U) WORK PERFORMED BY: Technology and advanced development efforts for ATF are being managed by the Air Force Systems Command/Aeronautical Systems Division, Wright-Patterson AFB OH. Lockheed California Co, Burbank CA and Northrop Corp, Hawthorne CA are the prime weapon system contractors for the Demonstration/Validation phase. As a result of teaming agreements, Boeing and General Dynamics will be principal subcontractors to Lockheed, and McDonnell Aircraft Co will be principal subcontractor to Northrop. The advanced engine development is also being managed by the Air Force Systems Command/Aeronautical Systems Division, Wright-Patterson AFB OH. Engine development contractors are Pratt and Whitney Aircraft Group of West Palm Beach FL and the General Electric Co of Evendale OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2472, ATF

A. (U) Project Description: This project continues development of the next generation air superiority fighter aircraft design with the performance and survivability features required to counter advanced Soviet fighters that will appear in large numbers in the early 1990s. In this advanced development project, flight vehicle technologies, design concepts, subsystem approaches, advanced materials, etc, that will be important to achieving ATF program and capability objectives will be demonstrated and validated. This will be accomplished through the use of trade-off analysis, detailed design work, wind tunnel and radar cross section tests, materials and component design tests, as well as hardware demonstrations including fabrication and flight testing of air vehicle prototypes.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Contract awards were preceded by a Joint Requirements and Management Board (JRMB) Milestone I review. On October 30, 1986, contracts for the competitive Demonstration/Validation phase were awarded. The Systems Requirements Reviews (SRR) were held, in which system level design information and the contractors' plans for building the prototype avionics demonstrator and aircraft were reviewed. These designs are intended to be used to develop a preliminary overall system specification for ATF. Advanced materials tests, subscale wind tunnel tests, radar cross section model tests, and system supportability demonstrations began in FY 1987. Initial fabrication of prototype components began. As a result of the SRR, several adjustments were made to both the requirements documents (System Operational Requirements Document) and the contractors' Preferred Systems Concepts.

(2) (U) FY 1988 Program: Detailed design and fabrication of ATF prototype aircraft is continuing. Materials tests of critical sub-assemblies are under way. Radar cross section tests will be conducted on full-scale components, and wind tunnel tests will proceed on large scale inlets and aerodynamic models. Testing of the ground demonstrator engines is continuing. Deliveries of initial avionics components will begin, and the buildup of the avionics integration lab will continue. Contracts for the prototype engines will be awarded.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, fabrication of the prototype flight vehicles will be completed and integration of propulsion, flight control subsystems, and flight test instrumentation initiated. First flight of the prototypes will occur in early FY 1990. Partial and full up demonstrations on the avionics integration lab will occur, as well as some flight demonstrations of selected avionics components. System Design Reviews will be conducted with both prime weapon system contractors.

(4) (U) Program to Completion: Flight tests of prototype aircraft will continue through FY 1990. In early FY 1991, source selection will culminate in awards to a single airframe contractor/team and a single engine contractor for the Full-Scale Development (FSD) phase.

C. (U) Major Milestones:

| | Milestones | | Dates |
|---|---|---|---|
| (1) (U) | Mission Element Need Statement approved by Defense Resources Board | | November 1981 |
| (2) (U) | Technology and Concept Development Contract Awards | | September 1983 |
| (3) (U) | Release of Demonstration/Validation Request for Proposal | | October 1985 |
| (4) (U) | Milestone I (Requirements Review) | | 4th Quarter FY 1986 |
| (5) (U) | Milestone II (FSD and Long Lead Decision) | | 1st Quarter FY 1991 |
| (6) (U) | First Flight (FSD aircraft) | *(3rd Quarter FY 1993) | 1st Quarter FY 1993 |
| (7) (U) | Milestone III (High Rate Production Decision) | *(4th Quarter FY 1994) | 1st Quarter FY 1996 |
| (8) (U) | Initial Operational Capability | *(2nd Quarter FY 1996) | 4th Quarter FY 1996 |

*Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Change

(6) (U) First flight of the Full-Scale Development (FSD) aircraft moved forward 6 months to permit longer flight test.

(7) (U) Milestone III delayed approximately 1 year to increase time available for flight test.

(8) (U) Initial operational capability slipped 6 months as a result of program restructure to reduce concurrency.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2878, Advanced Tactical Fighter Engine (ATFE)

A. (U) Project Description: The advances in propulsion technology sought in the ATFE project will be essential to achieving the significant capability improvements needed in the next generation air superiority fighter, including efficient supersonic cruise, increased reliability, and reduced logistics support. This project funds a competitive prototype engine demonstration of two advanced engine designs. To support the flight demonstration of prototype ATF aircraft with ATFE engines prior to FSD, this project has been restructured to obtain flight release of prototype engines in the FY 1989-1990 timeframe and to do the necessary development/fabrication work to protect the weapon system FSD schedule.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Fabrication of ground based demonstrator engines was completed and testing initiated. ATF system specifications resulting from the System Requirement Reviews were used to define specifications for the FSD engine/nozzle and plan its detailed design. Mechanical operability and performance tests of competing demonstrator engines were conducted.

(2) (U) FY 1988 Program: Contract award and fabrication of prototype engines and long lead release of FSD engine materials will occur. Structural, performance, operability control, and augmentor control testing will be initiated on engines for the prototype aircraft.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Performance and durability tests will be completed on prototype aircraft engines in FY 1989. Flight release of these engines will be obtained and fabrication of FSD engines will begin.

(4) (U) Program to Completion: First flight of the prototype air vehicles with the prototype engines will occur in early FY 1990. Continued build-up of FSD engines will take place in FY 1990. Flight testing of prototypes will continue into FY 1991 with the winner of FSD source selection continuing as part of the aircraft FSD program.

C. (U) Major Milestones: The relevant milestones for the Advanced Tactical Fighter Engine project are the same as those shown for the ATF project.

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2995, Critical Subsystems Development

A. (U) Project Description: The purpose of this project is to demonstrate that certain subsystems employing advanced technologies critical to the development of the ATF can be successfully integrated into an effective system. Several critical technologies in weapons integration, avionics integration, and advanced radar/sensor development must be matured prior to aircraft design freeze. The state-of-the-art microelectronics, sensors, advanced integrated avionics subsystems, and weapons systems developed for ATF in this project will make it possible to process extraordinary amounts of sensor data and vastly improve the pilot's capabilities for threat definition, situational awareness, aircraft fire and flight control, weapon/countermeasure systems management, etc. This project began in FY 1985 and will be completed in time to support a Full-Scale Development (FSD) decision in FY 1991.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The avionics architecture specification and ATF System Requirements Review were completed in mid-FY 1987, and have been used as the basis for initiating the design and fabrication of the ground-based avionics prototype as well as installation and flight test in avionics test bed aircraft. These will serve as the pre-FSD systems integration and testing laboratories for the ATF avionics architecture, subsystems, and data processing modules, as well as the validation tools for much of the equipment defined in Joint Integrated Avionics Working Group specifications. ATF system specifications from System Requirement Review will also be used to define preliminary subsystem parameters for the radar/electro-optical sensors.

(2) (U) FY 1988 Program: Development of the avionics integration prototype laboratory is continuing with initial integration tests and simulations. Advanced development modules (ADM) of avionics components and subsystems (e.g., 1750 data processors, high speed data bus, common signal processor modules, etc.) will be integrated and demonstrate an operating system. Design and fabrication of prototype sensor components and subsystems will be conducted. Large scale wind tunnel tests of weapons bay separation will be initiated.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, additional ADM hardware will be incorporated into the avionics integration prototype, including components derived from the Integrated Electronic Warfare System/Integrated Communications, Navigation, Identification Avionics effort (PE 0603109F). Fabrication of prototype sensor components and subsystems will be completed, and ground and rooftop tests will begin.

(4) (U) Program to Completion: Tests verifying fault isolation/fault tolerance and other key aspects of the integrated avionics architecture will be performed in FY 1990. In addition, critical elements of the avionics architecture will be flight demonstrated operating as an integrated system in avionics test bed aircraft. In FY

1990-1991, subsystem specifications for the sensor suite will be finalized, and fabrication of components will be initiated, aiming at delivery of full-scale development sensors in FY 1993-1994. Weapons bay separation tests will also be conducted in FY 1990 using the prototype ATF air vehicles. The Demonstration/Validation program will culminate in FY 1991 with a source selection for Full-Scale Development (FSD). Efforts during FY 1991 will complete testing and demonstrations and provide the final data to support the FSD decision.

C. (U) Major Milestones: The relevant milestones for the Critical Subsystems Development project are the same as those shown for the ATF project.

11. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603260F | Title: Intelligence Advanced Development

DOD Mission Area: 327, Tiara for Tactical Warfare | Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 4,867 | 4,058 | 4,994 | Continuing | N/A |
| 3479 | Advanced Sensor Exploitation | 1,200 | 1,274 | 1,300 | Continuing | N/A |
| 3480 | Automated Imagery Exploitation | 1,700 | 1,384 | 1,900 | Continuing | N/A |
| 3481 | Knowledge Based Technology For Intelligence | 1,200 | 1,050 | 1,700 | Continuing | N/A |
| 3482 | Scientific & Technical Intelligence Methodologies | 767 | 350 | 94 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops and demonstrates advanced technology for intelligence systems capabilities and techniques which support tactical and strategic combat commanders and the National Command Authority (NCA) needs for timely and all-source intelligence information. The program objectives are to develop improved analytical techniques and training systems to support USAF warfighting missions, to expand and improve intelligence data storage, retrieval and handling capabilities, and to satisfy needs for ear-real-time data processing, exploitation and dissemination from present and future advanced sensors. The program element is oriented toward solving specific shortfalls and deficiencies as defined by Air Force major commands, unified and specified (U&S) commands, and Scientific and Technical (S&T) Intelligence organizations.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 4,912 | 5,074 | 5,796 | Continuing | N/A |

EXPLANATION: (U) Congressional reduction of funds in FY 1987 and FY 1988. Due to fiscal constraints, AF reduced funding in FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Related Program Elements include: 0604750F, Intelligence Equipment; 0602702F, Command, control and Communications; 0603742F, Combat Identification Technology, for emergent technology; 0102310F, WWNCCS ADPNORAD; 0207411F, EIFEL Improvements; 0207412F, Tactical Air Control System Improvements; 0207422F, Tactical Air Control System communications; 0207431F, Tactical Air Intelligence Systems; 0604321F, Joint Tactical Fusion Program; 0207435F, Tactical Imagery Processing, Exploitation and Dissemination; 0303152F, WWMCCS Information System; 0603208F, Reconnaissance Sensor Development; 0603718F, Electronic Warfare; 0603789F, Command, Control & Communications Advanced Development and 0603726F, Optic Development for engineering development of demonstrated solutions to operational requirements. Projects within this program element are coordinated with Army, Navy, Marine Corps and other DOD activities.

6. (U) WORK PERFORMED BY: The program is managed by Air Force Systems Command, Andrews AFB, MD, with project efforts being conducted by Rome Air Development Center (RADC), Griffiss AFB, NY.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project 3479, Advanced Sensor Exploitation (ASE): The ASE program was inititated to develop a correlation and processing capability utilizing multi-sensor products as inputs. The goal of the ASE program is near-real-time all source correlation fusion using expert systems for receipt, correlation, templating and analysis of sensor data. In FY 1987, development continued on correlation/fusion algorithms to support the Joint Tactical Fusion Program (JTFP). A Budget Estimate Agreement (BEA), 13 May 1986, established a working relationship between the JTFP Program Management Office and the Rome Air Development Center (RADC) for the purpose of insuring exploratory and advanced development activities and to insure the orderly transition of appropriate software to the JTFP office. In addition, the BEA will provide a testbed environment to test and evaluate software (other sources) prior to transition to the JTFP. Activities in FY 1986 were accomplished under PE 0603789F (Command, Control Communications, Advanced Development) Project 2315. In FY 1987, the ASE Program was transferred to PE 0603260F, Intelligence Advanced Development. Under the ASE project, development of operational, intelligence data correlation, algorithms continued and enchancements to the ASE testbed (scenario generation module, sensor simulation module, correlation & processing module) were implemented. In FY 1988-1989, efforts will continue with advanced development of artificial intelligence software/hardware for the Tactical Air Force's ASE program. This task is known as the AI situation assessment module. In addition, efforts will continue with the development of an enhanced sensor simulation package which will permit simulation of multiple sensor packages. Advanced development efforts to continue with completion of the target analysis module, the target prioritization aid, air order of battle update and completion of C3CM tactics analyzer.

B. (U) Project 3480, Automated Imagery Exploitation (AIE): The objective is to develop technology advancements required for real and near-real time multi-source imagery exploitation in a ground station environment. Advances in the technologies of automated target detection, classification, identification, advanced data handling and processing hardware will be demonstrated and evaluated on a testbed. Implementation of expert systems will provide the capability to automate imagery interpretation by augmenting human intelligence in the manpower intensive task of imagery exploitation. In FY 1986, the AIE task was accomplished under PE 0603789F. Efforts initiated to develop near-real-time target detection algorithms to support emerging imagery exploitation. A draft technology transition plan, August 1986, was initiated to provide a transition vehicle for RADC technologies into the Advanced Deployable Digital Imagery Support System (ADDISS). Nine technologies were identified as potential candidates: Image compression, Image

reformatting, geopositioning, auto target detection, Tactical Optical Disk, Digital cartographic applications, classification, identification and flat panel displays. In FY 1987, the AIE Project transferred to PE 0603260F, Intelligence Advanced Development. Efforts began on Intelligence Image compression to provide increased storage of multi-sensor imagery data, increased transmission of imagery through band limited channels and to limit image degradation. In addition, efforts were initiated on intel/information reformatter technology to provide a real-time capability to accept multi-sensor reconnaissance imagery and reformat into a common standard. FY 1988-1989 efforts include image compression tasks and intel/information reformatter technology task. In addition, RADC will refine the cartographic application for Tactical & Strategic System (CATSS) technology to provide the algorithms & software necessary to display and manipulate cartographic background, data geographic names and geoposition data. The planned transition date for CATSS is 1st Qtr FY 93. In FY88 the 3-D Recce project was transferred to PE 0603260F from PE0603248; this project is to develop methods of exploiting elevation data in images, and is expected to provide major improvements in ability to extract imagery data.

C. (U) Project 3481, Knowledge Based Technology for Intelligence: The project includes several tasks designed to develop advanced computer software (expert systems) based on artificial intelligence techniques. Specific tasks include: Air Force Space Command's Aerospace Warning; The Air Force Electronic Warfare Center's EW Flagging Program; The Electronic Security's Command's Tactical Analysis Program; and the Air Force Intelligence Service's Denial & Deception Expert Systems. Four knowledge based (Expert system - Artificial Intelligence) tasks initiated to support the intelligence analyst. The objective of the Aerospace Warning task is to develop prototype advanced computer subsystem modules to provide warnings and assessment of foreign space and missile activity in the prelaunch (launch prediction), trans-launch (launch assessment) and post-launch (orbit analysis) phases. The electronic warfare flagging task will provide computer software to assist electronic-warfare analysts in a near-real-time Electronic Intelligence (ELINT) analysis and reprogramming capability. The objective of the Tactics Analysis Program is to develop computer expert system software to accelerate the analysis of foreign aircraft tactics and capabilities and provide timely dissemination to the Tactical Commands. The purpose of the Denial & Deception Expert Systems is to develop and prototype, image-based software for the Air Force Intelligence Service to assist analysts in rapid detection and monitoring of foreign D & D activities. In FY 1988-1989, follow-on efforts will continue with the Advanced Development of Artificial Intelligence Software/Hardware for AFSPACECOM's Aerospace Warning project. Development will continue on rule-based software for the Air Force Electronic Warfare Center's EW Flagging Analysis, Electronic Security Command's Tactics Analysis Program, and the Air Force Intelligence Service's Denial & Deception Task. Projects will support Air Force Intelligence functions and operational forces by improving automation of Battlefield Imagery Exploitation and Intelligence Decision Aid software.

D. (U) Project 3482, Scientific and Technical Intelligence Methodologies: In FY88 the Rapid Application of Airpower (RAAP) task from PE 0603248 was transferred to PE 0603260. This task is to provide automated incorporation of intelligence on enemy doctrine and tactics for improved decision making to rapidly and optimally apply airpower. In FY 1987, two tasks were initiated: Scientific and technical intelligence methodologies and operational employment simulation research. The scientific and technical intel methodologies task will aid FTD to conduct studies and present feasibility demonstrations oncurrent foreign capabilities and potential threats. RADC will specifically initiate development of the Aircraft Avionics Analytical Model Study. The operational employment simulation research will give FTD the capability to digitally model and simulate the performance of threat weapons in a projected operational environment. Specific applications include development of an Automated Model Evaluation Station (AMES), development of model data translator programs and the development of a data based query language. Development will

continue on coventional software for the Foreign Technology Division's operational employment simulation project. In FY88 two further tasks are to be initiated: Scientific and Technical Reporting Information Processing System (STRIPS) and the ELINT Analysis Expert System (EATS). STRIPS is to develop means of improved on-line merging of S&T intelligence data during imagery exploitation. EATS is to develop methods for direct automated analysis of signal waveforms.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603307F    Title: Air Base Operability Advanced Dev
DOD Mission Area: 214 - Ground Base Anti-Air and Tactical Missile Defense    Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 5,750 | 2,988 | 5,128 | Continuing | N/A |
| 3018 | Air Base Operability | 4,060 | 2,000 | 3,414 | Continuing | N/A |
| 3140 | Camouflage, Concealment, and Deception | 1,690 | 988 | 1,714 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Air Base Operability (ABO) integrates operational concepts with research, development and acquisition programs to improve a sustained sortie generation capability should an attack occur on or close to an air base. The Air Force must provide enough people, aircraft, facilities and key supporting systems so that theater air bases can survive an enemy attack allowing air power to be continuously and effectively employed throughout the conflict.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 5,797 | 4,426 | 5,132 | Continuing | N/A |

EXPLANATION: (U) Congressional reduction of funds in FY 1988. This reduction in a level-of-effort funded program has eliminated field assessment team assistance for Major Air Commands, and deferred theater-level effectiveness modeling of multiple air bases until FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not applicable.

5. (U) RELATED ACTIVITIES: The Full Scale Development efforts that follow this Advanced Development work are provided in PE 0604617F, Air Base Operability, and continue through the Five Year Defense Plan.

6. (U) WORK PERFORMED BY: Program contractors are Computer Science Corporation, Bay St Louis MS; Softech Incorporated, Alexandria VA; Orlando Technology Incorporated, Orlando FL: Verac Incorporated, San Diego CA; and TRW Defense Systems Group, Redondo Beach CA (all working on Air Base Survivability). There is one additional contract with

a value of $120,000. In-house development organizations are Armament Division, Eglin AFB FL; Aeronautical Systems Division and Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB OH; Air Force Engineering and Services Center, Tyndall AFB FL; and Electrohic Systems Division, Hanscom AFB MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3018 Air Base Operability (ABO). Air Base Operability is a multi-faceted program with five mutually supporting elements: active defense; passive defense; base recovery; command, control and communication survivability; and aircraft enhancements. This project provides advanced development efforts for active and passive defense, base recovery, and command, control and communication survivability. It also funds the continuing integration, planning and technology demonstration activities of the ABO Systems Management Office (SMO). The SMO is responsible for integrating all ABO activities Air Force wide and performing cost effectiveness analyses on ABO requirements and programs for meeting them. The FY 1987 funding continued the operations and initiatives of the SMO which included: preparation for a demonstration of the survivable BRAAT communications network; continuation of the development of the utility survivability model; analyses to support the Investment Strategy Planning (ISP), VANGUARD analyses and the field assessment team visits at other bases; expansion of effectiveness modeling to include Southwest Asia; and test of improved Explosive Ordnance Disposal clearing equipment. The FY 1988 funding is continuing analyses for the ISP and VANGUARD, development of a methodology to optimize investments in ABO based on contributions to combat sortie generation, publishing the ABO Integration Plan, initial operation of the ABO Data Center, and demonstration of Air Base Ground Defense detection equipment and procedures. The FY 1989 request funds the continued analyses that support the annual investment strategy planning process, VANGUARD, the utility survivability model, theater-level effectiveness modeling of multiple air bases, and incorporation of the utility survivability model into the ABO models. The ABO Data Center and the ABO Integration plan will require significant support to keep information on each air base's survivability capabilities and overall ABO Planning objectives current. This level of effort project is expected to continue at least through FY 1995, continuing to integrate the many varied facets of ABO, providing modeling and analyses to assure our most critical needs are met and highest payoff areas are provided priority.

B. (U) Project: 3140, Camouflage, Concealment, and Deception (CCD). This project covers the full spectrum of CCD methods to mitigate the effectiveness of enemy attacks against airfields. The project includes advanced development work on decoys, obscuration concepts, and optical and electronic sensor deception. Using data from previous testing, demonstrations, and analyses, advanced development will be conducted on the most promising and appropriate technologies. Studies will continue to identify how different techniques affect vision or visual perception and identify the best technologies for that purpose. Aircraft decoys transitioned to full scale development in FY 1987. Other efforts involve studies of radar deception by radar reflectors, light weight camouflage nets for unsheltered aircraft, and studies of employment capabilities for large area smoke screens (all transitioning in FY 1988). These are part of the first phase of CCD. The advanced CCD efforts (CCD Phase II) will begin late in FY 1988 with a study to determine cost effective measures that will address electronic deception of electronic sensors

through active means and passive means other than radar corner reflectors. This study will consider radio frequency, infrared, and ultraviolet sensor deception techniques. Advanced development in CCD Phase II will continue through FY 1991. As suitable techniques are identified in this advanced development effort, they will transition to full scale development. These transitions are expected to begin no earlier than FY 1990.

8. (U) **PROJECT OVER $10 MILLION IN FY 1989:** Not applicable.

9. (U) **COOPERATIVE AGREEMENTS:** Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603320F
DOD Mission Area: 224 - Defense Suppression

Title: Lower Cost Antiradiation Seekers
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 16,795 | 13,533 | 12,453 | 7,665 | 77,163 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element is for development of the High Speed Antiradiation Missile (HARM) Low Cost Seeker (LCS). The increased sophistication, concentration, and lethality of enemy ground based radar guided missile and antiaircraft artillery systems threaten the ability of tactical aviation to accomplish its mission and survive. Antiradiation missiles provide a lethal counter to this threat. The Tactical Air Forces require a system that enhances aircraft survivability during mission accomplishment. A variety of antiradiation weapon concepts are under consideration to accomplish this goal. The LCS is a US Navy derivative concept of the US Army Antiradiation Projectile design which provides an opportunity to meet increased HARM performance requirements at lower unit costs. HARM is being acquired by the Navy and Air Force to meet an immediate need for an upgraded capability against current threats. The F-4G Wild Weasel represents the only dedicated lethal defense suppression weapon system in the Air Force inventory and HARM is its primary weapon.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 16,796 | 13,586 | 12,465 | 7,665 | 66,228 |

EXPLANATION: (U) Increase in total cost includes $11 million applied to LCS development in FY 1984 and FY 1985 but not previously reported under this Program Element (PE).

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable. Procurement funding will be under a separate Program Element (PE 27317F) per Congressional direction or in the existing HARM PE 27162F.

5. (U) RELATED ACTIVITIES: HARM, PE 27162F, has been designated as the primary antiradiation missile for the F-4G Wild Weasel. A July 1975 Memorandum of Agreement between the Air Force and Navy Assistant Secretaries for Research and Development names the Navy as the Executive Service and the Air Force as the Participating Service in the Joint Service HARM Development Program. Within the HARM program, the prime contractor, Texas Instruments, Inc, is funding development of an upgrade to the HARM seeker (Block IV) in parallel with LCS development. Both seekers will be required to have the same level of improved performance required to counter the qualitative increases in enemy

surface-to-air missile systems. The Services' plans to improve HARM capability were provided to Congress on July 24, 1987 in the HARM Improvement Plan. The F-4G APR-38 Radar Homing and Warning Receiver is optimized in Program Element 27136F, F-4G Wild Weasel Squadrons, to fully utilize HARM's capabilities. Navy resources for Lower Cost Seeker (LCS) development are in Program Element 0603320N.

6. (U) WORKED PERFORMED BY: The two primary contractors who performed work for this program effort were Ford Aerospace and Communications Corporation, Newport Beach CA, and Raytheon Company, Missile Systems Division, Lowell MA. Ford Aerospace was competitively selected to complete full scale development. Air Force program management is provided by Headquarters Air Force Systems Command, Andrews AFB MD, and its subordinate organization, Armament Division, Eglin AFB FL. Government facilities such as the Aeronautical Systems Division, Wright-Patterson AFB OH, Naval Weapons Center, China Lake CA, and the Air Force Flight Test Center, Edwards AFB CA, are also utilized. Air Force participation in joint operational testing will be conducted by the Air Force Operational Test and Evaluation Center, Kirtland, AFB NM.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:.

(U) Project: 0603320F, Lower Cost Antiradiation Seekers

A. (U) Project Description: This program supports the design and development of an alternate, directly replaceable, reduced-cost guidance section which meets the operational requirements of the AGM-88 High Speed Antiradiation Missile (HARM). The HARM Lower Cost Seekers (LCS) program adapts technology derived from the Antiradiation Projectile (ARP) program and other advanced, passive, radio frequency (RF) guidance technologies to USN and USAF requirements for an antiradiation guided missile, specifically HARM. ARP and RF technologies will be applied to the design of HARM antenna and receiver subassemblies (seeker). These technologies have a potential for substantially reducing parts count, number of electrical connections, and design sensitivities. The resulting HARM guidance sections will exhibit greater reliability and enhance producability at reduced cost. The Air Force, as the Participating Service in the Joint Navy/Air Force LCS program, will contribute the funds programmed in the FY 1988/FY 1989 President's Budget to LCS development and those development efforts that are unique to the Air Force. The Air Force's emphasis is to integrate the LCS with the HARM, the F-4G, and the F-16 Launcher Avionics Package. This integration requires the development and testing of computer software to certify the missile for carriage and launch from the aircraft, the ground/flight tests of the avionics/missile interface. Additionally, peculiar Air Force ground support equipment and technical manuals will be developed.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The brassboard models were completed in the third quarter FY 1987 and underwent limited development testing.

(2) (U) FY 1988 Program: A Navy Program Decision Meeting approved start of Full Scale Development. A source selection was held in February 1988 to evaluate contractor designs and downselect to one contractor. The software design responsibility will be transferred from the Naval Weapons Center, China Lake, CA, to the contractor over a 15 month period. The contractor will refine the hardware design and perform component and seeker level testing.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The contractor will manufacture 45 production prototype model seekers for delivery in FY 1990. Contractor Development Test and Evaluation (DT&E) will continue.

(4) (U) Program to Completion: Production prototype model deliveries will be completed. DT&E and Initial Operational Test and Evaluation (ground qualification, captive flight, and firings) will be accomplished in Fiscal Year 1990. Fabrication of one hundred initial production items will begin in FY 1990 and will be completed in FY 1993.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Contracts Award | | April 1985 |
| (2) | (U) | Critical Design Review I | | January 1986 |
| (3) | (U) | Brassboard Models Complete | (December 1986)* | June 1987 |
| (4) | (U) | Brassboard Development Testing | (November 1986-June 1987)* | June 1987-October 1987 |
| (5) | (U) | Milestone II Review | (July 1987)* | January 1988 |
| (6) | (U) | DT&E | (December 1987-October 1988)* | January 1988-December 1989 |
| (7) | (U) | Production Prototype Units Complete | (September 1988)* | July 1990 |
| (8) | (U) | USAF IOT&E (1A) | (October-November 1988)* | January-September 1990 |
| (9) | (U) | Low Rate Initial Production Decision | (January 1989)* | March 1992 |
| (10) | (U) | USAF IOT&E (1B) | (March-August 1989)* | May 1991-March 1992 |
| (11) | (U) | USAF IOC | (September 1991)* | August 1992 |

* Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes:

(3, 4 & 5) (U) Technical problems caused delays in hardware availability and subsequent testing.

(6, 7, 8, 9, 10 & 11) (U) Delays in brassboard testing and program restructuring. Restructuring included the transfer of total system performance responsibility from the government to the contractor.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603714F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 950 | 908 | 936 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development of the Department of Defense Base and Installation Security System, a standardized set of components, interfaces, and methodology for creation of exterior physical security systems, by accomplishing advanced development tasks in three functional areas: detection, command and control and imaging. A Department of Defense need exists for a family of standardized modular equipment which can be integrated into system configurations to provide a level of security in consonance with the deployment mode, threat level and sensitivity of the asset being protected. The resulting security equipment increases the capability of the security forces to detect and intercept terrorists and permits increased mobility of the forces for better utilization of existing manpower.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands).

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 951 | 912 | 937 | Continuing | N/A |
| Other Procurement | 0 | 8,288 | 8,404 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Other Procurement (0207589F) | | | | | |
| Funds | 0 | 9,713 | 10,972 | Continuing | N/A |
| (Spares funds not included) | | | | | |
| Quantities | Not Applicable | | | | |

5. (U) RELATED ACTIVITIES: Engineering Development tasks are accomplished under Program Element 0604715F, Department of Defense Physical Security Equipment-Exterior (Engineering Development). Procurement of physical security equipment is accomplished using Other Procurement-Air Force funding under Program Element 0207589F, Air Force Physical Security Systems. The Base and Installation Security System equipment will be designed for interoperability with the Army interior security system (facility intrusion detection system) and the Army tactical sensor system (remotely monitored battlefield sensor system). Management oversight of the physical security equipment program is provided by the Department of Defense Physical Security Equipment Action Group with the Chairperson residing in the Office of the Under Secretary of Defense for Acquisition.

PE: 0603714F

6. (U) WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, Electronic Systems Division, Hanscom AFB, MA. Department of Defense agencies performing development tasks are: Rome Air Development Center, Griffiss AFB, NY; Army Mobility Equipment Research and Development Command and Army Night Vision Laboratory, Fort Belvoir, VA; Army Waterways Experimental Station, Vicksburg, MS; Naval Ocean Systems Center, San Diego, CA; and the Naval Coastal Systems Center, Panama City, FL. In addition to these Defense agencies, the Department of Energy/Sandia National Laboratory, Albuquerque, NM performs development tasks, and Analytical Systems Engineering Corp. assists with systems engineering support and integration tasks. Contractors presently developing security systems under this effort include E-Systems, Fairfax, VA; Computing Devices Company, Ottawa, Canada; Magnavox Electronics Systems Company, Ft Wayne, ID; Teledyne Controls Corp., Los Angeles, CA; Sanders Assoc., Nashua, NH, and ISC Corp. Lancaster, PA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0603714F, DOD Physical Security Equipment-Exterior

A. (U) Project Description: Continues advanced development of physical security systems with primary emphasis placed on sensors (detection), sensor processing techniques, and imaging subsystems. Advanced development projects include an infrared charged coupled device for sensor applications.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Development of the infrared charge coupled device and advanced signal processing technologies to improve sensor capabilites continued. Commercial sensor evaluation and entry control technology also were evaluated for DOD applications.

(2) (U) FY 1988 Program: Development of the infrared charged coupled device will continue for sensor applications under no/low light conditions. Sensor signal processing techniques and commercial sensor evaluation for use in DOD applications will be continued. Evaluation of various entry control devices for DOD entry control applications will be continued. Category III, budgetary, cost estimate is based on inputs from various government agencies performin these development efforts. The cost estimate was updated in September 1987.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Evaluation of commercial products for use in DOD applications will be continued. Advanced Sensor space processing techniques will continue to be investigated and efforts will be initiated for advanced sensor concepts. A Category III, budgetary, cost estimate for this effort is based on inputs from various government agencies performing these development efforts. The estimate was updated in September 1987.

(4) (U) Program to Completion: Efforts initiated in FY 1986 and earlier will be continued and transitioned to engineering development as appropriate. Development will be continued to provide security systems to protect Air Force resources commensurate with the required level of security and threat. This is a continuing program.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603742F[1] Title: Combat Identification Technologies
DOD Mission Area: 344 - Tactical Command and Control Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROJECT ELEMENT | 5,948 | 0[1] | 1,949 | Continuing | N/A |
| 2597 | Noncooperative Identification Subsystems | 0 | 0 | 1,649 | Continuing | N/A |
| 2599 | Cooperative Identification Techniques | 5,948 | 0 | 0 | N/A | N/A |
| 3765 | Joint-Service Noncooperative ID Technologies | 0 | 0 | 300 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program element is to accomplish engineering development of systems that will provide reliable environments. This program is is an identified in the area. Without the required our weapon systems cannot be used in the most efficient manner and their total performance potential cannot be fully realized against the of the projected threat. The of the threat demands that we engage the enemy at is a prerequisite for such engagements. It

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 6,005 | 1,457 | 1,951 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not Applicable.

Notes: 1. This PE was included in the consolidated EW PE 64241 in FY 88 at the direction of Congress.

5. (U) RELATED ACTIVITIES: Several complementary cooperative and noncooperative identification techniques as well as their integration are being developed under the Air Force led, Tri-Service Combat Identification System Program. Work accomplished under this program element is part of an integrated Tri-Service effort to improve United States identification capabilities worldwide. Related activities include: Program Element (PE) 0604725F, Combat Identification Systems; Program Element (PE) 0603267N, NATO Future Identification System; PE 0603515N, Advanced Identification Techniques; PE 0603706A, Identification Friend or Foe (IFF) Developments; PE 0604211N, Air Traffic Control Radar Beacon System/Mark XII; and PE 0604709A, IFF Equipment. Coordination and integration of the various activities under these program elements are accomplished through the Air Force led Tri-Service, Combat Identification System Program.

6. (U) WORK PERFORMED BY: This program is managed by the Air Force, Wright Aeronautical Laboratories/Avionics Laboratory, Wright Patterson AFB, OH and Rome Air Development Center, Griffiss AFB, NY. Additionally, the following contractors are engaged in work under this program: Veda Incorporated, Dayton, OH; Scope Electronics, Reston, VA; Westinghouse Electronics, Baltimore, MD.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 2597, Noncooperative Identification Subsystems. This project accomplishes the engineering development of the most promising methods for noncooperative target identification (NCTI). Primary emphasis is on techniques that can be applied to current and future USAF tactical aircraft as well as tactical command and control systems Techniques/technologies developed under this project will also be examined for application to joint-service platforms and, where applicable, will be used to form the basis of joint-service projects under Project 3765. The FY 1988 request supported the initiation of numerous NCTI technology demonstrations of advanced active and passive NCTR technologies to determine their maturity and feasibility for further development and future for applicability to These demonstrations are exploring

The FY 1989 request supports the continuation of the demonstrations leading to a selection of the most promising techniques which can be Subsequent outyear efforts will initiate actions to baseline these techniques into specific

B. Project: 3765, Joint-Service Noncooperative ID Technologies. This project supports the joint development of Noncooperative Target Identification technologies for use on multiple weapon systems/platforms. The initial effort is a Tri-Service development program to improve the previously developed, and currently fielded, Radar Algorithm, called Dual Mode Recognizer (DMR) in the Air Force. The DMR algorithm, identifies

Air Force participation in this joint-service effort supports the development of a common Advanced Radar Signal Modulation algorithm to provide

The FY 1988 request supported the Air Force share of the funding that started the joint-service (Navy, Army, Air Force) program developing a common Advanced Radar Signal Modulation algorithm and The FY 1989 request supports the continued development of a common Tri-Service Advanced Radar Signal Algorithm and In FY 1990 and beyond, preliminary investigations will begin to baseline this common algorithm for incorporation into

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604201F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Aircraft Avionics Equipment Development
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 23,169 | 16,934 | 19,630 | Continuing | N/A |
| 2257 | Standard Avionics and Joint Services Review Committee (JSRC) Initiatives | 4,688 | 3,774 | 3,772 | Continuing | N/A |
| 2258 | Standard Inertial Navigation Unit (INU) | 5,763 | 2,700 | 2,603 | Continuing | N/A |
| 2297 | Embedded Computer Software Standardization | 2,353 | 2,100 | 1,995 | Continuing | N/A |
| 2519 | Airborne Radar Improvements | 7,231 | 420 | 1,370 | Continuing | N/A |
| 2560 | JOVIAL Language Control Facility | 932 | 640 | 521 | Continuing | N/A |
| 2658 | Avionics Architecture Implementation and Support | 951 | 800 | 694 | Continuing | N/A |
| 3264 | Standard Flight Data Recorder (SFDR) | 1,251 | 6,500 | 8,675 | 12,130 | 29,326 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops standard avionics architectures a equipment to reduce support costs and allow technology evolution to provide operational force improvements. Reliability and Maintainability (R&M) considerations play a major role in the identification of specific development efforts within this program. Joint avionics development efforts are pursued through participation in and support of the Joint Services Review Committee (JSRC). Current JSRC initiatives undergoing development at this time include a Ground Collision Avoidance System and a Standard Flight Data Recorder. This program also supports generic radar applications to improve performance, reliability and maintainability of current Air Force airborne fire control radars. Finally, this program funds necessary ongoing support activities to ensure a credible avionics standardization program is maintained.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 21,907 | 19,685 | 22,648 | Continuing | N/A |

EXPLANATION: (U) FY 1987 addition was reprogrammed by Air Force to fund unplanned development associated with integration of Standard Inertial Navigation Units in Project 2258. FY 1988 reduction is a result of FY 1988 Congressional actions. FY 1989 reduction reprogrammed by Air Force for higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is closely coordinated with the Army and Navy to maximize joint developments where feasible. Multiservice initiatives are supported through participation in the Joint Services Review Committee. In addition, a Tri-Service memorandum of agreement has been established to promote interservice standardization. A Standard Flight Data Recorder and Ground Collision Avoidance System are being developed jointly with the Navy and Army. There is a close relationship between the products of this program and the technological building blocks developed in advanced and exploratory development programs such as PE 0603109F, Advanced Systems Integration Demonstration; PE 0603203F, Advanced Avionics for Aircraft; PE 0603253F, Advanced Systems Integration Demonstration; and PE 0602204F, Aerospace Avionics. Techniques, components and subsystems showing high payoff potential can be progressively transitioned through the development process until a specific weapon system application is identified and an engineering development task established. The Airborne Radar Improvements project investigates the generic radar improvements possible with initial application in the F-15, F-16, and B-1B. For example, radar electronic counter-countermeasures test data obtained from PE 0603750F, Counter/Countermeasures Advanced Development, will aid in developing software for this project.

6. (U) WORK PERFORMED BY: Program management is provided through Air Force Systems Command by the Aeronautical Systems Division, Wright-Patterson AFB, OH. Major contracts of Project 2257 are with the Analytic Sciences Corporation, Reading, MA; Oneida Resources, Inc., Dayton, OH; and Aeronautical Radio Inc., Annapolis, MD; Systems and Applied Sciences Corporation, Dayton, OH; and the Charles Stark Draper Laboratory, Inc., Cambridge, MA. Project 2258 is currently contracted to Honeywell Corporation, Clearwater, FL, Litton Systems, Inc., Woodland Hills, CA, and Singer Kearfott Corporation, Little Falls, NJ. The Project 2297 contractor is Proprietary Software Systems, Santa Monica, CA. Project 2519 is contracted with Hughes Aircraft Corporation, Culver City, CA, Westinghouse Electric Corporation, Baltimore, MD., and Support Systems Associates, Inc., Dayton, OH. The project 2560 contractor is SOFTECH Inc., Waltham, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2257, Standard Avionics and Joint Services Review Committee (JSRC) Initiatives. This project assists the Deputy for Avionics Control, Aeronautical Systems Division, with identification and assessment of systems and subsystems to be developed and/or designated as Air Force standard items through interface with Air Force Systems Command (AFSC), Air Force Logistics Command (AFLC), and the operational Major Commands (MAJCOMs). It evaluates the standardization potential of candidate systems and, when necessary, initiates hardware development. It also develops specifications and standards for systems/subsystems that have been approved for standardization. Coordination with appropriate services is accomplished through participation in and support of the JSRC. During FY 1987, efforts to develop a Tri-Service Next Generation Avionics Computer MIL-STD continued as did efforts to define a Modular Avionics Systems Architecture (MASA) that uses Line Replaceable Modules (LRMs) and is applicable to new and existing aircraft. During FY 1988, development of a Tri-Service specification for a Standard Compass will take place. Development of the Tri-Service Next Generation Avionics Computer MIL-STD will continue. MASA/LRM definition work will continue through use of DOD/Industry-wide open forums. During FY 1989, MASA/LRM FSD definition work will continue with development of standards and specifications for LRMs and other key elements. An evaluation of the standardization potential of single point keying technology will also be performed. During FY 1990 and beyond this ongoing project will continue providing the front-end activity needed to determine the feasibility of standardizing selected avionics systems/subsystems identified through the Air Force and Joint Service avionics planning process. Support of JSRC initiatives will continue with development of the Tri-Service Next Generation Computer architecture MIL-STD. Development of standards deriving from single point keying technology will be begin, as will an evaluation for the potential development of a family of standard power supplies.

B. (U) Project: 2258, Standard Inertial Navigation Unit (INU). This project upgrades the Air Force's Standard Form, Fit, Function ($F^3$) and F-15 Medium Accuracy (0.6 nm/hr) INUs by incorporating ring laser gyro (RLG) technology to provide significant improvements in reliability and maintainability. In addition, this effort also funds development efforts related to incorporation of a Precision Accuracy (0.2 nm/hr) INU. The $F^3$ INU program consists of a demonstration portion to show that no degradation of navigation accuracy occurs in a vigorous military aircraft environment, and a qualification portion where inertial navigation unit (INU) manufacturers are required to submit their respective systems for testing to ensure compliance with the Standard $F^3$ INU specification (SNU 84-1). $F^3$ INU development is funded by each contractor while the Air Force funds all demonstration/acquisition testing costs at the Air Force's Central Inertial Guidance Test Facility (CIGTF). Initial applications are targeted to the F-4, F/FB/EF-111, A-7, C-130, C-17, HH-53, and OV-10 aircraft. The F-15 Ring Laser Gyro (RLG) Inertial Navigation Unit (INU) program includes development and certification of multiple sources for the F-15E and F-15 A-D retrofit programs. The Precision Accuracy INU program includes certification of a Standard Form, Fit, Function ($F^3$) Precision Accuracy INU for Special Mission C-130 (Combat Talon I and II) and AC-130 Gunship aircraft. During FY 1987, both $F^3$ and F-15 RLG INU flight demonstrations/verifications were conducted. In addition, $F^3$ RLG INU transparency demonstrations were performed to demonstrate the ability of the $F^3$ INU units to be used on multiple aircraft types with no hardware retrofit required. CIGTF qualification testing of Precision Accuracy RLG INUs also commenced during this period. During FY 1988, Development of integration/engineering changes to the Standard and F-15E RLG INUs will continue. Precision Accuracy RLG INU

qualification testing will be completed. Early work to define an Integrated Inertial Reference Assembly (IIRA) will commence. During FY 1989, full scale development (FSD) of the (IIRA) will start. During FY 1990 and beyond, this ongoing program will continue to update the Standard INU to allow incorporation of new technologies such as Very High Speed Integrated Circuits (VHSIC), Fiber Optics and other new technology gyros, etc. In addition, IRA FSD will continue.

C. (U) Project: 2297, Embedded Computer Software Standardization. This project supports and maintains the Embedded Computer Standardization Program Office (ECSPO) within the Air Force's Deputy for Avionics Control. The purpose of the project is to develop support software to allow implementation of selected avionics architectural standards such as MIL-STD-1589 (JOVIAL J-73), MIL-STD-1815A (Ada) and MIL-STD-1750A 16-bit Computer Instruction Set Architecture (ISA). The ECSPO provides Air Force weapon system programs with timely, high quality compilers and associated support software, such as assemblers, linkers, debuggers, and simulators in support of the above listed military standards. During FY 1987, support of JOVIAL and MIL-STD-1750A software support tool problem report/corrections continued. Version releases of JOVIAL/MIL-STD-1750A related software were/are scheduled during both FY 1987 and 1988. Development of a production quality Ada/MIL-STD-1750A compilation system continued. This system is a follow-on effort to a prototype Ada/1750 compilation system developed by the Air Force Wright Aeronautical Laboratories (AFWAL) using technology originally demonstrated by the Rome Air Development Center (RADC). During FY 1988, support of JOVIAL and MIL-STD-1750A software support tools will continue. Since current JOVIAL/MIL-STD-1750 software are considered to be production quality and are presently in the maintenance phase, it is the intent of this program to transfer program management responsibility (PMRT) to AFLC starting in this period. Development of the Ada/1750 compilation system will continue with the completion of an initial production compilation system (PCS). During FY 1989 and beyond, development of the Ada/MIL-STD-1750A compiler tool set will continue as will support of JOVIAL and MIL-STD-1750A software support tools for the over 300 ECSPO users currently being supported.

D. (U) Project: 2519, Airborne Radar Improvements. This project supports development of generic radar improvements for current Air Force airborne fire control radar systems. Emphasis is on improving reliability and maintainability (R&M) and developing common mode capabilities among the F-15, F-16 and B-1B radar systems with minimum duplication of effort. In addition, this project supports coordinated radar development between the Air Force laboratories, aircraft system program offices, contractors, and other users. During FY 1987 transition of electronic counter-countermeasures (ECCM) technology continued with emphasis on ECCM applications. F-15 Radar Built-In Test (BIT) improvement and Coolanol contamination investigations continued. During FY 1988 development of F-15 BIT improvements will be completed. F-16 and B-1B Radar Roadmaps will be completed. The Coolanol Contamination investigation will be completed. During FY 1989, the feasibility of utilizing terrain based navigation techniques in concert with airborne radar systems will be examined. During FY 1990 and beyond, this program will continue to explore new radar technologies for transition to full scale development. ECCM technology baseline transition activities will continue and updates to the F-15, F-16, and B-1B Radar Roadmaps will be provided on an annual basis.

E. (U) Project: 2560, JOVIAL Language Control Facility (LCF). This project supports the JOVIAL Language Control Facility (LCF), a service organization established by the language control agent to ensure the stability and configuration of the JOVIAL language (MIL-STD-1589C). The LCF provides control and maintenance of standard language definitions, control of software support tools, and compiler validation testing. In addition, the LCF provides both government and industry users advice and assistance in using and implementing JOVIAL for embedded systems applications. It is estimated that under full operation the JOVIAL language standardization effort saves the Air Force $15 million a year in compiler acquisition costs alone. During FY 1987, the LCF validated 5 compilers for compliance with the MIL-STD, participated in 3 JOVIAL/Ada Users Group meetings, conducted 10 JOVIAL training classes for some 200 personnel, and published 4 issues of the JOVIAL LCF Newsletter. During FY 1988 JOVIAL validation and user support will continue with some 5-10 compilers validated, participation in 3 JOVIAL/Ada Users Group meetings, and 6 JOVIAL training classes offered. For FY 1989 and beyond this ongoing program will continue support of the JOVIAL language until such time as all programs transition to the Ada high-order language.

F. (U) Project: 2658, Avionics Architecture Implementation and Support (AAIS). This project supports the Systems Engineering Avionics Facility which provides for the development and support of avionics architectural standards such as the MIL-STD-1553B Multiplex Data Bus, MIL-STD-1750A 16-Bit Computer Instruction Set Architecture and MIL-STD-1760 Aircraft/Stores Electrical Interconnection System. It carries out necessary validation testing and provides consultation and engineering support for development and support of new and existing avionics architectural standards. Applicable new technologies are also investigated and appropriate new standards developed as required. During FY 1987, MIL-STD-1553B and 1750A verification/validation activity continued. During this period some 9 MIL-STD-1553B and 10 MIL-STD-1750A validations were performed. For FY 1988, some 16 MIL-STD-1553B and 18 MIL-STD-1750A validations are projected. During FY 1989 and beyond this ongoing support program will continue.

G. (U) Project: 3264, Standard Flight Data Recorder (SFDR). This project provides for development of a crash survivable SFDR to replace current Aircraft Structural Integrity Program (ASIP) flight structures recorders currently in use and to provide the capability for recording crash incidence data. The SFDR is a Joint Services Review Committe (JSRC) sponsored initiative that capitalizes on development pursued within the F-16 program office. Currently the system is configured with a signal acquisition unit for processing and recording flight structures and other information, and an optional crash survivable memory unit, used to provide crash incidence data following a mishap. In FY 1987, interface control documentation was defined for SFDR installations for the some 17 Air Force production and retrofit aircraft and one Navy retrofit aircraft. During FY 1988, an SFDR full scale development contract will be awarded for application to 18 different aircraft types, including the F-15E, F-16A/B Air Defense Fighter (ADF), YA-7F, C-17, and Air Force Logistics Command's ASIP flight recorder retofit program. During FY 1989, flight testing of trial integration units on operational will be conducted and production deliveries for F-16A/B ADF and C-17 SFDRs will begin.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604212F
DOD Mission Area: 225 - Air Warfare Support

Title: Aircraft Equipment Development
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 4,636 | 1,931 | 1,138 | Continuing | N/A |
| 1926 | Aircraft Windshield Development | 2,501 | 1,931 | 1,138 | Continuing | N/A |
| 2098 | Aircraft Accessories Development | 1,778 | 0 | 0 | 0 | 6,623 |
| 2377 | Airdrop Systems Support | 357 | 0 | 0 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force updates its aircraft due to changing threats, equipment obsolescence and technical advancements, and to improve safety, efficiency, and effectiveness of operational aircraft. This program element develops, tests and evaluates aircraft subsystem equipment to satisfy these operational needs. Technological advances in aircraft equipment are exploited and translated into operational hardware. This is the only engineering development program element which utilizes advanced state of the art technology to develop windshield systems with improved hazard resistance and reduced cost of ownership.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 4,700 | 1,939 | 2,139 | Continuing | N/A |

EXPLANATION: (U) The reduction in FY 1989 reflects fiscal guidance and redirection of funds to higher priority programs. This reduction will result in a reduction of personnel, a halt in all work on the B-1B, T-38, and F-15E transparencies until FY 1990, and cancellation of the F-16, A-7, and F-4 efforts.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The following program elements relate to this program element: 0401115F, C-130 Squadrons; 0401118F, C-141 Squadrons; 0602201F, Aerospace Flight Dynamics; 0603203F, Advanced Avionics for Aircraft; 0603211F Aerospace Structural Materials; 0604201F, Aircraft Avionics Equipment; 0604226F, B-1B; and 0708026F, Productivity, Reliability, Availability and Maintainability. The Air Force works jointly with sister services in the development of airdrop systems.

6. (U) WORK PERFORMED BY: The contractors are: Pittsburgh Plate Glass Co., Huntsville, AL (1926); University of Dayton Research Institute, Dayton, OH (1926); Gila Bend Indian Reservation, Gila Bend, AZ (2098); and Ver-Val Corporation, Fort Walton Beach, FL (2377). The program manager is Aeronautical Systems Division, Wright-Patterson Air Force Base, Dayton, OH.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 1926, Aircraft Windshield Development.

A. (U) Project Description: This project applies the latest aircraft windshield technology to improve birdstrike resistance at high speed, while maintaining high optical quality, durability, minimum weight and low life cycle cost. The threat of birdstrike is continuing to grow due to increasing emphasis on low altitude, high speed missions.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Completed DT&E of A-7 windshield. Continued OT&E of F-111 transparencies, F/RF-4 single piece windshield, and T-38 windshield system. Initiated DT&E of an improved F-16 canopy that is intended to provide four pound bird/500 knot (vice current 350 knot) resistance, OT&E of A-7 windshield, and development of improved B-1B windshield to improve optics, durability and cost.

(2) (U) FY 1988 Program: Complete DT&E of improved F-16 canopy, OT&E of F-111 transparencies and T-38 windshield system. Continue OT&E of A-7 windshield and F/RF-4 single piece windshield, and DT&E of F-16 canopy. Initiate DT&E of improved B-1B windshield.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete OT&E of F-111 transparency system to correct the flight safety hazard caused by service life structural degradation. Postpone all developmental work on transparencies for B-1B, T-38, and F-15. Cancel all work on F-16, A-7, and F-4.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604218F
DOD Mission Area: 225 - Air Warfare Support

Title: Engine Model Derivative Program (EMDP)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 61,025 | 979 | 957 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: EMDP is an engineering development program that provides the latest engine technology advances to current weapon systems and provides a framework for engine development for future systems. EMDP contributes to system life extension, reduced life cycle cost, and enhanced performance. The latter is required to counter increases in system weight and increased threat capability. EMDP demonstrates derivative engine concepts incorporating demonstrated technology and advanced components from government funded programs and contractor Independent Research and Development. EMDP demonstrates technology in performance, durability, operability, supportability, reliability, maintainability, and other unique capabilities, such as thrust reversing and vectoring nozzles. These demonstrations are in prototype engines prior to full scale development. EMDP can also evaluate alternate engine candidates to provide competitive engine opportunities for selected military aircraft systems. Candidates for competition may be commercial or military engines in either use or in development.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 61,941 | 979 | 982 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: For requisite technology, EMDP draws gas generator core engine technology (high pressure compressor, combustor, and high pressure turbine) from PE 0603216F, Advanced Turbine Engine Gas Generator. Fan, low pressure turbine, and limited engine test data are provided by PE 0603202F, Aircraft Propulsion Subsystem Integration. Advanced component technology is also obtained from PE 0602203F, Aerospace Propulsion. Other principal inputs including materials processing and component fabrication demonstration come from PE 0708011F, Industrial Preparedness Program. Activities conducted by the Navy, National Aeronautics and Space Administration, the Army and propulsion industry in-house programs also constitute significant sources of technology. The Air Force and the Navy have a broad memorandum of understanding for joint cooperative propulsion programs in areas of common interest. Efforts in PE 0604268F, Aircraft Engine Component Improvement Program, directed toward engine flight safety problems, service revealed deficiencies and the achievement of durability goals complement the EMDP development process.

6. (U) WORK PERFORMED BY: EMDP is managed by the Deputy for Propulsion at Aeronautical Systems Division, Wright-

Patterson AFB, OH. The contractors (and engines) involved are: Pratt & Whitney Aircraft (P&W), West Palm Beach, FL (F100, F117, and V2500); General Electric Company (GE), Evendale, OH (F101, F108, F110); Williams International, Walled Lake, MI (FJ44, F107); Allison, Indianapolis, IN (RB211-535E4, 250 propfan); Teledyne CAE, Toledo, OH (235 propfan, J69); and Garrett Corporation, Phoenix, AZ (F109, TFE1042/1088).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: PE 0604218F, Engine Model Derivative Program (EMDP)

A. (U) Project Description: EMDP ensures the Air Force has propulsion alternatives for near- and far-term needs. The only other way to provide this is through full scale weapon system development. EMDP conducts early engineering development leading to a prototype derivative of an existing engine. Early demonstration of improved engine characteristics (performance, operability, durability, reliability, and maintainability) significantly reduces risk and shortens engine development and qualification. This provides a more immediate response to potential weapon system needs. Current tasks include: (1) F100 Increased Performance - Demonstrate a higher thrust F100 engine having Alternate Fighter Engine (AFE) levels of durability, operability, reliability, and maintainability. The engine configuration includes an increased efficiency compressor and floatwall combustor, plus the fan, augmentor and low pressure turbine (LPT) from the F100 EMDP concluded last year. (2) F110 Increased Performance - Demonstrate a higher thrust F110 engine having AFE durability, operability, reliability, and maintainability. The engine configuration includes a digital engine control, upgraded core and LPT to run at higher combustion temperatures. (Items (1) and (2) are integral to the Tactical Fighter Roadmap for higher performance engines to be qualified in CY 1989 for installation in F-15s and F-16s delivered in CY 1991.) (3) EMDP Initiatives - Initiate evaluation studies of cruise missile propfan engines, low observable engine technologies, vectored nozzles, advanced controls for tactical engines, upgraded engines for T-37 aircraft, and competitive applications of advanced engine technology.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: F100/F110 Increased Performance - Completed Increased Performance tests, including sea level, altitude (at Arnold Engineering Development Center), and 4000 cycle durability. New Initiatives - Evaluated the P&W V2500 as a competitor to the GE F108 for KC-135Rs; evaluated the Allison RB211-535E4 and the P&W F117 as replacement engines for B-52s; and evaluated the durability of the Williams FJ44 for trainer aircraft application. Initiated study of propfan engines for cruise missile application.

(2) (U) FY 1988 Program: Evaluate tactical engine low observables (LO), vectoring nozzles, thrust and advanced controls capabilities. Initiate design work for a propfan cruise missile engine demonstration program.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Begin limited hardware development and rig testing for a propfan cruise missile engine (CME). Complete preliminary designs for axisymmetric vectored nozzles and advanced control systems for current and future increased capability engines. Initiate increased thrust and LO engine designs for future increased capability engines.

(4) (U) Program to Completion: The propfan CME program will conduct flight demonstrations and transition to full scale development pending an evaluation of the EMDP results. An increased capability engine will demonstrate axisymmetric nozzle, advanced controls, increased thrust and LO capabilities. EMDP is a continuing effort. The level of funding for EMDP is derived from bottom up estimates to conduct the demonstrations and objectives for each EMDP effort. These estimates are reviewed by technical and management specialists at Aeronautical Systems Division.

C. (U) Major Milestones

| | Milestones | | Dates |
|---|---|---|---|
| (1) (U) | F100 Increased Performance Engine | | |
| | Contract Award, Phase II, III | | May 1986 |
| | Demonstration Engine Testing Complete | | August 1987 |
| (2) (U) | F110 Increased Performance Engine | | |
| | Contract Award, Phase II, III | | July 1986 |
| | Demonstration Engine Testing Complete | | August 1987 |
| (3) (U) | FJ44 AEDC Test | | February 1987 |
| | V2500/KC-135 Study | *(March 1987) | May 1987 |
| | B-52 Re-engine Evaluation | *(not reported) | December 1987 |
| | Propfan Cruise Missile Engine Evaluation | *(not reported) | January 1988 |

*Dates reported in FY 1988/FY 1989 Descriptive Summary

(U) EXPLANATION OF MILESTONE CHANGES

(3) (U) V2500/KC-135 contract award was delayed pending resolution of negotiations.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604222F
DOD Mission Area: 242 - Theater Wide Nuclear Warfare

Title: Nuclear Weapons Support
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 ACTUAL | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 4,224 | 4,427 | 2,177 | Continuing | N/A |
| 5708 | Nuclear Weapons Support | 2,224 | 2,150 | 2,177 | Continuing | N/A |
| 3629 | SAC Security Upgrades | 2,000 | 2,277 | 0 | 750 | 5,027 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Project 5708 provides funds for salaries of the Air Force Weapons Laboratory cadre of civilian nuclear weapon specialists who provide technical guidance to the Department of Energy and direction to the North Atlantic Treaty Organization (NATO) for fulfillment of United States Air Force responsibilities related to the development and support of nuclear weapon systems. Includes funds to demonstrate weapon/warhead compatibility to delivery platforms. Supports Strategic Air Command (SAC) Required Operational Capability 16-71 (Peacekeeper); 12-76 (Air Launched Cruise Missile); 6-76 (B61 Strategic Bomb); 6-69 (B83 Modern Strategic Bomb); 15-83 (Short Range Attack Missile II); 1-83 (Small Single Reentry Vehicle Intercontinental Ballistic Missile); Tactical Air Force Statements of Operational Need 304-77 (Ground Launched Cruise Missile); 306-86 (Nuclear Tactical Air-to-Surface Missile (TASM)); Strategic Air Command Statement of Operational Need 002-85; Aircraft Delivered Weapon to Counter Deeply Buried; Hardened Targets; and 009-84 Weapon to Counter Deeply Buried Superhard Time-Urgent Targets. Project 3629 funds are provided for the prototype development of SAC Security Upgrades of alert areas to protect nuclear weapons-loaded aircraft from terrorist attack. Military construction funds to install these devices are contained in Project Element 010896F starting in FY 1989.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 2,263 | 4,444 | 2,179 | Continuing | - |

EXPLANATION: (U) The Congress cut without prejudice $2.0 million from the SAC Security Upgrades Program in FY 1987. Reprogramming efforts were successful.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Project 3629 Military Construction: | 0 | 0 | 6,500 | 83,500 | 90,000 |

5. (U) RELATED ACTIVITIES: Related Department of Energy nuclear weapon RD&T, production, and surveillance activities for Air Force systems is funded separately at over $1/3 billon per year. Air Force activities which are related to the warhead development in this program element include PE 0604312F (Intercontinental Ballistic Missile Modernization); PE 0101215 (Peacekeeper); PE 0101219 (Small ICBM ); PE 0101213 (MM II); PE 0604361F (Air Launched Cruise Missile (ALCM)); PE 0604362F (Ground Launched Cruise Missile (GLCM)); PE 0603319F (Advanced Cruise Missile (ACM) Technology); and PE 0603364F (Short Range Attack Missile (SRAM) II). Activity related to nuclear weapon carrier modification/upgrade includes PE 0101113F (B-52 Offensive Avionics System); PE 0101115F (FB-111B/C); PE 0101118F (SRAM); PE0101213F (Minuteman Squadrons); PE 0604226F (B-1B); and PE 0101126F (B-1B). Bomber alert area obscuration devices and taxiway barriers, to be developed and tested under Project 3629, will be constructed at Strategic Air Command bases. Project 3629 construction funds (approximately $90 million) are included in PE 0101896F.

6. (U) WORK PERFORMED BY: Work is primarily performed by the Air Force Weapons Laboratory, Kirtland AFB, NM.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 5708, Nuclear Weapons Support

A. Project Description: Activities in this project include nuclear weapon development, nuclear weapon and delivery platform compatibility demonstration, support equipment certification, and nuclear weapon data development and evaluation efforts. Nuclear weapon programs either in development or production that are supported include the B83 and B61-3/4 gravity bombs, the B61-7 gravity bomb (safety and security upgrade of the B61-1 gravity bomb), the W87 Peacekeeper, the W80 ALCM/ACM, the W84 GLCM warheads (The AFWL lead POG will provide a key interface for return of the W84 in accordance to the INF accord.), SICBM and SRAM II warheads. Weapon parachute development flight tests in support of both new weapons and upgraded older weapons are also supported. Compatibility efforts include maintaining nuclear certification of US and North Atlantic Treaty Organization nuclear systems, providing for the development of nuclear weapon practice bombs, and maintaining and updating all nuclear weapon related Technical Orders. Integration of ALCM's W80-1 warhead into the Advanced Cruise Missile was initiated, and reactivation and safety improvememts to the B53 bomb were accomplished. In FY 1988 efforts include continued support of Peacekeeper and SICBM warhead activities. Work to

integrate ACM and SRAM II, along with the B53-1, B83 and B61-7, into the strategic bomber forces is continuing. Integration of B61-3/4 into US and NATO tactical aircraft continues. Work on GLCM continues with emphasis on INF treaty execution. Long range efforts on a Tactical Air-to-Surface Missile (TASM) as well as efforts toward development of Earth Penetrating Weapon (EPW) to counter deeply buried targets. These efforts will continue through FY 1989.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: The B61-3/4, W80, B83, B61-7 and W84 continued production and deployment during the year. Production of the Peacekeeper warhead also continued to insure warheads in FY 88. Congressional restrictions limit the DOE build to W87 warheads for the first 50 Peacekeeper missiles. A Stockpile Confidence Test (SCT) of the was successfully accomplished. Pending Senate ratification of INF, W87-1 Phase 2A activities for SICBM were concluded as integration efforts proceeded with few problems. W80 integration efforts for the Advanced Cruise Missile (ACM) are progressing satisfactorily. Phase 2A activities for the SRAM II were also concluded after considerable debate by OSD factions seeking to promote alternative less costly but less capable weapon design.

Considerable study and staffing activities for an Earth Penetrating Weapon to hold deeply buried hardened Soviet command and control facilities at risk.

(2) FY 1988 Program: Nuclear weapon production will continue for the W87 Peacekeeper warhead, the B83 strategic bomb, the W80-1 ALCM/Advanced Cruise Missile warhead, the B61 tactical bomb, and full scale development for both the SRAM II(W89) and SICBM(W87-1) warheads will continue. The B53 strategic bomb will be returned to the SAC inventory after approval by the Air Force and OSD safety groups. A feasibility study (Phase 2) for EPW will continue to study attacking deeply buried hard targets. Tactical Air- to-Surface Missile (TASM) Phase 2 study may be required to select a suitable warhead. A TASM Phase 2A cost definition study may be possible The development of concepts for Strategic Air Command (SAC) alert bomber protective screening devices and alert taxiway barriers will continue albeit at reduced and uncertain schedule because of funding limitations. Bomber protective screening devices will provide protection against small arms fire for nuclear weapons loaded B-52, FB-111, and B-1B aircraft. At some SAC bases, bomber alert areas are vulnerable to attack from off base locations. Concepts for alert taxiway barriers will continue development for SAC alert areas to help prevent unauthorized access to a nuclear weapon/weapon system. Currently, the taxiways are protected by armed guards.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Production of the warhead for Peacekeeper will occur in FY 1988, with the remaining warheads (spares and quality assurance) being built in FY 1989. The B61, W80-1, and B83 will continue production. The W84 (GLCM) warhead will begin to be returned to reserve status assuming that the INF accord is ratified. Both the SRAM II and SICBM will enter Phase 4, Production Engineering. The SAC alert bomber protective screening devices and taxiway barrier concept development will continue with some chance of transition to engineering development. There is a potential to start integration of an interim EPW capability in the and continued Phase 2A activity for TASM. Depending on a Congressional decision to deploy more than 50 missiles, warhead production may continue. The B61, W80-1, and the B83 will continue production. If a Tactical Air-to-Surface Missile requirement is solidified, a Phase 2 or 2A study may be required before engineering development will begin (Phase 3). Strategic Relocatable Target and Hard Target Kill weapons will probably begin engineering development if successful advanced development has occurred earlier.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604223F
DOD Mission Area: 225 - Air Warfare Support

Title: Alternate Fighter Engine (AFE)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 102,171 | 76,616 | 28,052 | 44,051 | 512,687 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides funds to complete Full Scale Development (FSD) of the F110-GE-100 Alternate Fighter Engine (AFE), as well as development and integration of Configured Engine Bays (CEBs) in both F-15 and F-16 aircraft which provides capability to accept either F110 or F100 engines. Supports the competitive acquisition of durable, supportable, and affordable fighter engines for the expanding F-15 and F-16 fighter fleets which began with FY 1986 aircraft engine deliveries. This program element also funds FSD for the F100-PW-229 and F110-GE-129 Increased Performance Engines (IPEs), derivatives of the AFEs. IPEs give F-15s and F-16s the capability to counter the evolving improved threat. The IPE program leads to engine qualification by April 1989, with production availability for field service evaluation in January 1990, and for delivery to new production F-15s and F-16s in January 1991.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 105,050 | 86,915 | 28,078 | 44,051 | 525,891 |

EXPLANATION: (U) Decreases are due to Congressional action. The FY 1988 reduction eliminates a portion of the planned flight testing and delays completing engine life assessment until after the IPEs are deployed.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program completes the development of the F110-GE-100 AFE which was initiated under PE 0604218F, Engine Model Derivative Program (EMDP). The EMDP on the F110 (previously F101 Derivative Fighter Engine) was conducted under a Memorandum of Understanding with the Navy. The Navy is procuring F110s to re-engine their F-14 aircraft. Preliminary development for F100 and F110 IPEs was performed under EMDP.

6. (U) WORK PERFORMED BY: The engine programs are managed by the Deputy for Propulsion at Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH. Contractors for the AFE and IPE programs are: General Electric Company, Evendale, OH and Pratt and Whitney, West Palm Beach, FL. The configured engine bay development programs are managed by the Deputy for F-15 and the Deputy for F-16 and at ASD, Wright-Patterson AFB, OH. Contractors for the configured engine bay (CEBs) are McDonnell Douglas Corporation, St. Louis, MO (F-15), and General Dynamics, Fort Worth, TX (F-16).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: PE 0604223F Alternate Fighter Engine (AFE)

A. (U) Project Description: This program element funds the Full Scale Development (FSD) of the General Electric F110-GE-100 engine to provide a competitive alternative to the Pratt and Whitney F100-PW-220 engine. The Air Force competes these two engines each year in the AFE competition, to procure engines for annual F-15 and F-16 aircraft production. The program also includes the development of CEBs for F-15 and F-16 aircraft that accept either the F110-GE-129 or the F100-PW-229. Beginning in FY 1986, this program funded the FSD of F100 and F110 Increased Performance Engines (IPEs). These engines will incorporate advanced technology to provide higher thrust while maintaining current AFE levels of durability, operability, reliability, maintainability and supportability. IPEs will be available in CY 1990 for a field service evaluation and in CY 1991 for F-15 and F-16 production deliveries.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FSD of the IPEs continued. Production designs were completed and development of unique support equipment, technical orders and other logistic support articles began. FSD test engines were fabricated and assembled. Sea level engine testing for Initial Service Release (ISR) was initiated. Flight testing of preproduction engines was initiated. The development of the CEB for F-15 aircraft continued with static/fatigue tests and fit checks of an F110-GE-129 engine.

(2) (U) FY 1988 Program: During FY 1988, each IPE contractor will: (1) continue sea level development testing (up to 300 hours); (2) continue altitude testing at Arnold Engineering Development Center (up to 200 hours); and (3) conduct a 4000 cycle accelerated mission test (AMT) for qualification. These tests will satisfy the ISR requirements. The FSD program for F100 and F110 IPEs also includes flight testing of the ISR (production) configuration. This program will lead to a noncompetitive procurement of both engines in FY 1989 for use in a field service evaluation. The program also leads to a competitive procurement of either or both engines in FY 1990 for use in F-15 and F-16 aircraft to better meet the improved performance threat at that time. F-15 CEB work will continue with flight testing of a CEB-configured F-15 aircraft with an F100-PW-220 engine.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Residual tasks from the qualification effort will be completed. The F110-GE-129 and F100-PW-229 IPEs will continue FSD with full life testing of the preproduction configurations including another 4000 cycle AMT during FY 1989. This full life demonstration will satisfy part of the requirements of Operational Capability Release, the fourth and final stage of FSD, by identifying life limiting design deficiencies prior to full rate production of the engines. The program will also include updating the technical data for the F100 and F110 Increased Performance Engines (IPEs) and provide integration flight test support for these engines in the F-15 and F-16 flight test programs. F-15 CEB testing will complete in FY 1989.

(4) (U) Program to Completion: The F100 and F110 IPE programs will continue through FY 1990 with Operational Capability Release (OCR) testing on a production configured engine. This will include performing an engine accelerated mission test with the production engines to verify full engine life. Update of engine maintenance and support procedures will also be accomplished under OCR.

C. (U) Major Milestones:

| Milestones for F110-GE-100 Alternate Fighter Engine | Dates |
|---|---|
| (1) (U) Production Verification Accelerated Mission Testing | January 1984 |
| (2) (U) Production Verification Sea Level Testing | October 1984 |
| (3) (U) Production Verification Altitude Testing | January 1985 |
| (4) (U) Integration Flight Test (F-16XL) | January 1985 |
| (5) (U) First Production Engine Delivery | February 1985 |
| (6) (U) Production Verification Flight Test (F-16C) | June 1986 |
| (7) (U) First F-16C/D Delivery with F110 Engine | July 1986 |

| Milestones for F100-PW-229 Increased Performance Engine | | Dates |
|---|---|---|
| (1) (U) Contract Go Ahead | | June 1985 |
| (2) (U) Preliminary Design Review | | November 1985 |
| (3) (U) Critical Design Review | | May 1986 |
| (4) (U) Initial Flight Release | *(July 1987) | March 1988 |
| (5) (U) Production Design Review | | August 1987 |
| (6) (U) Functional Configuration Audit | *(September 1988) | October 1989 |
| (7) (U) Initial Service Release | *(September 1988) | April 1989 |
| (8) (U) Physical Configuration Audit | | January 1990 |
| (9) (U) First Production Engine Delivery for Field Service Evaluation | | January 1990 |
| (10) (U) Operational Capability Release | | December 1990 |
| (11) (U) First Production Engine Delivery for Production F-15s/F-16s | | January 1991 |

* Dates presented in FY 1988/89 Descriptive Summary.

| Milestones for F110-GE-129 Increased Performance Engine | | Dates |
|---|---|---|
| (1) (U) Contract Go Ahead | | June 1985 |
| (2) (U) Preliminary Design Review | | November 1985 |
| (3) (U) Critical Design Review | | May 1986 |
| (4) (U) Initial Flight Release (IFR) | *(July 1987) | February 1988 |
| (5) (U) Production Design Review | | August 1987 |
| (6) (U) Functional Configuration Audit (FCA) | *(September 1988) | August 1989 |
| (7) (U) Initial Service Release, (ISR) | | September 1988 |

| Milestones for F110-GE-129 Increased Performance Engine (Continued) | | Dates |
|---|---|---|
| (8) (U) Physical Configuration Audit (PCA) | *(January 1990) | November 1989 |
| (9) (U) First Production Engine Delivery for Field Service Evaluation | *(January 1990) | October 1989 |
| (10) (U) Operational Capability Release | | December 1990 |
| (11) (U) First Production Engine Delivery for Production F-15s/F-16s | | January 1991 |

* Dates presented in FY 1988/89 Descriptive Summary.

(U) **Explanation of Milestone Changes**

(U) **F100-PW-229:**

(4) (U) IFR moved to allow redesign and test to solve problems discovered early in development testing.
(6) (U) FCA moved to align the audit with data availability.
(7) (U) ISR moved to allow redesign and test to solve problems discovered early in development testing.

(U) **F110-GE-129:**

(4) (U) IFR moved to align with flight test schedules.
(6) (U) FCA moved to coincide with production engine availability.
(8) (U) PCA moved to coincide with production engine availability.
(9) (U) First Production Engine Delivery moved to support the Field Service Evaluation.

9. (U) **COOPERATIVE AGREEMENTS:** Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604231F — Title: C-17 Program
DOD Mission Area: 261 - Intertheater Airlift — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 615,716 | 1,115,550 | 961,067 | 1,549,300 | 4,827,800 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Additional airlift capability is needed for rapid inter-theater deployment of combat forces to support national objectives and for timely intratheater movement to meet forward area mobility requirements. Airlift is vital to meet U.S. mobility requirements and is tailored to respond to contingencies anywhere in the world. Specific tasks associated with the airlift mission area include deployment, employment (airland, airdrop, and extraction), sustaining support, retrograde, and combat redeployment. The C-17 will be capable of performing the entire spectrum of airlift missions and is specifically designed to operate effectively and efficiently in both the intertheater and intratheater environments. Therefore, it will not only increase our overall airlift capability, but will be able to replace the lost capability from retiring some C-130 an C-141 aircraft beginning in the 1990s. The C-17 will be a modern technology aircraft capable of performing the airlift mission well into the 21st century.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 626,262 | 1,219,904 | 981,977 | 1,395,448 | 4,809,748 |
| Aircraft Procurement | 49,076 | 723,700 | 1,093,700 | 28,482,000 | 30,348,476 |

EXPLANATION: (U) RDT&E: FY 1987 decrease (-$10.5 million) results from the C-17's share of undistributed DOD cuts and application of revised inflation rates. FY 1988 decrease (-$104.4 million) reflects results from Congressional/DOD reductions. FY 1989 decrease (-$20.9 million) results from OSD reductions. Total estimate RDT&E cost increase (+$18.0 million) results from recovering FY 1988 Congressional and FY 1989 OSD reductions in the outyears and application of revised inflation rates. Procurement: FY 1988 decrease (-$56.4 million) resulted from Congressional reduction. FY 1989 increase (+$14.0 million) recovers part of the FY 1988 Congressional reduction and reflects revised inflation rates. Total estimate procurement cost increase (+$243.6 million) results from recovering FY 1988 Congressional reductions in the outyears, revised spares funding and application of revised inflation rates.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement | | | | | |
| Funds | 49,076 | 667,300 | 1,107,700 | 28,768,024 | 30,592,100 |
| Quantities | 0 | 2 | 4 | 204 | 210 |

5. (U) RELATED ACTIVITIES: The Air Force is also pursuing near-term programs to provide additional airlift capability. These programs include procurement of C-5B aircraft in PE 0401119F, C-5 Airlift Squadrons, KC-10s in PE 0207222F, KC-10A, and increasing the Civil Reserve Air Fleet (CRAF) cargo capability in PE 0401215F, CRAF Modifications. These acquisitions, in conjunction with C-17, are part of the Air Force Airlift Master Plan to provide a balanced program for additional airlift that will meet the Congressionally Mandated Mobility Study recommended minimum airlift capability. The C-17 aircrew simulator development program is funded in PE 0604227F, Flight Simulator Development.

6. (U) WORK PERFORMED BY: A program office is established at Aeronautical Systems Division of Air Force Systems Command at Wright-Patterson Air Force Base OH. Douglas Aircraft Company, Long Beach, CA, has been selected as the prime contractor and was awarded a low-level development contract in July 1982. A full-scale development contract was awarded in December 1985. The Air Force Flight Test Center and the Air Force Operational Test and Evaluation Center will conduct developmental and operational flight testing in the full-scale development program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: PE 0604231F, C-17 Program

A. (U) Project Description: This program element develops C-17 aircraft which will carry outsized cargo over intercontinental distances into austere airfields. The C-17 is a major initiative to improve our rapid deployment capability, provide the lift capability to move heavy mechanized Army/Marine Corps equipment in-theater, and replace the capability lost from retiring some C-130 and C-141 aircraft beginning in the 1990s.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The engineering drawing release rate increased significantly. Structure development testing, design analysis, and design-to-life cycle cost studies continued. Initial tool fabrication activities began. Logistics planning studies and logistics support analysis development continued. Technical order publications began development. Reviews during FY 1987 included an air vehicle operation software preliminary design review and an air vehicle software system requirements review. The peculiar support equipment design analysis continued, documentation of Support Equipment Recommendation Data (SERD) increased, and initial support equipment development testing and technical data to support training systems efforts began. Tool planning and design effort continued to increase along with increased emphasis on tool fabrication leading to the start of construction of the partial development fixture. Detailed planning for flight and laboratory testing continued.

(2) (U) FY 1988 Program: Full-scale development will continue. Tooling activity will continue. Fabrication for the three full-scale test RDT&E articles and the first two production aircraft will begin. Assembly of the

flight test aircraft will begin. Subsystem development testing will continue. Systems simulator qualification testing for flight control systems, hydraulic systems, and fuel systems will begin. The 90 percent structural and 90 percent systems design and drawing release milestone will occur. Air vehicle hardware and software critical design reviews will be completed. Peculiar support equipment design and SERD documentation will continue. Training systems and equipment efforts will continue. Logistics efforts including logistics support analysis, technical publications, maintainability, and support studies and analysis will continue. Flight and laboratory detailed planning and laboratory testing will continue. RDT&E cost estimate is category II/mature.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Assembly of the durability test article, static test article, and the first two production aircraft will begin. The tooling effort to support low production requirements will be virtually complete. Continued development will take place on the development fixture. The organizational and intermediate support equipment preliminary design reviews will be completed. Planning for the RDT&E flight test aircraft air loads calibrations will be completed. Engineering design and drawing releases will be completed. Development of detailed test planning will concentrate on full-scale durability and static articles, and the RDT&E test aircraft. Full-scale engine testing will be initiated. Technical and logistics analyses will be continued. The technical data validation effort will be initiated using manufacturing articles. RDT&E cost estimate is category II/mature.

(4) (U) Program to Completion: Production design, assembly/test of durability/static test articles; design specifications on procurement items and software; and support equipment design will be completed. Subsystem and component development, flight simulator testing, and tooling and parts fabrication will be completed. Manufacturing assembly, flight test, and systems evaluation will be completed on the full-scale development flight test articles.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Contract Award | July 1982 |
| (2) (U) Defense Systems Acquisition Review Council (DSARC) II Decision | February 1985 |
| (3) (U) Complete Air Vehicle Preliminary Design Review | September 1985 |
| (4) (U) Begin RDT&E Test Article Assembly | 2nd Quarter FY 1988 |
| (5) (U) Complete Air Vehicle Critical Design Review | 4th Quarter FY 1988 |
| (6) (U) First Flight | 4th Quarter FY 1990 |
| (7) (U) 1 Life Cycle Complete on Durability Article | 1st Quarter FY 1991 |
| (8) (U) Development Test and Evaluation/Initial Operational Test and Evaluation Complete (except all-weather testing) | 1st Quarter FY 1992 |
| (9) (U) Initial Operational Capability | 4th Quarter FY 1992 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

Budget Activity: 4, Tactical Programs
Program Element: 0604231F, C-17 Program

AS OF: January 1988

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): Wind tunnel, structural and component testing has been conducted during the low level development and initial full scale development (FSD) phases of the program. Major test phases will be development ground testing, combined DT&E/Initial Operational Test and Evaluation (IOT&E), dedicated IOT&E, climatic hanger, hot weather climatic test deployment and post cold weather climatic deployment, and production acceptance test and evaluation. DT&E will be conducted to assist engineering design and development, verify accomplishment of specification requirements, characterize system performance, and insure critical issues have been sufficiently resolved to permit a full rate production decision. DT&E/IOT&E will be conducted using one FSD aircraft and four production aircraft. These aircraft will be tested at government test sites except for the first flight. Combined DT&E/IOT&E testing will be conducted at Edwards AFB, CA, under a combined test force with the Air Force Flight Test Center taking the lead in DT&E. Development tests include flying qualities, performance, airdrop as well as reliability, maintainability, and availability.

2. (U) Operational Test and Evaluation (OT&E): This is a multiservice, combined development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) program to be accomplished under the operational procedures of the Air Force Flight Test Center. The Air Force Operational Test and Evaluation Center (AFOTEC) is the lead agency for operational testing with the US Army/Marine Corps as the supporting test agencies. The purpose of the IOT&E is to evaluate the operational effectiveness and suitability of the C-17 aircraft in the operational environment and to identify operational deficiencies and the need for modifications. Although IOT&E test objectives will be integrated into the combined DT&E/IOT&E test program, there are five aircraft months (approximately 200 flight hours) of dedicated IOT&E to assess only OT&E objectives. The dedicated IOT&E will evaluate four critical issues: inter/intratheater range and payload, airdrop/airland capability, supportability, and mission reliability. Effectiveness testing will evaluate five major areas: small austere airfield operations, airdrop, air refueling, formation/low level, and strategic mission scenarios. Suitability testing will evaluate aircraft availability, mission and logistic reliability aircraft maintainability, logistics supportability, and software supportability. Assessments will also be made on system survivability and software maturity. Test missions will be conducted in the most realistic environment possible with deployments to Air Force and Army bases. This dedicated IOT&E will use Air Force "hands on" maintenance to the maximum extent possible.

3. (U) Systems Characteristics: All system performance, reliability, maintainability, and availability characteristics are specified in the contract with McDonnell Douglas Corporation. Demonstrated characteristics will not be available until FY 92.

Budget Activity: 4, Tactical Programs
Program Element: 0604231F, C-17 Program

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Aircraft Dimensions (Height, Length, Wing Span) | 55.3' x 175.2' x 165.0' | |
| Cargo Compartment Dimensions (Height, Width, Length) | 12.3' x 18.0' x 88.0' | |
| Max Allowable Cabin Load (ACL) | 172,200 lb | |
| Range (166,965 ACL) | 2,400 nm | |
| Takeoff Critical Field Length (2,400 nm/166,965 ACL) | 7,600 ft | |
| Maximum Effort Landing Field Length (123,977 ACL/500 nm return) | 2,650 ft | |
| Cruice Speed | 0.77 Mach | |
| Ground Maneuvering (runway width, 180 degree turn using backing) | 90 ft | |
| Reliability @ 100,000 fleet flying hours (system mission completion success probability) | 93 % | |
| Maintainability @ 100,000 fleet flying hours (air vehicle maintenance manhours per flight hour) | 18.6 | |
| Availability @ 100,000 fleet flying hours | | |
| (full mission-capable rate) | 74.7 % | |
| (partial mission-capable rate) | 82.5 % | |

4. (U) Current Test and Evaluation (T&E): DT&E/IOT&E (flight testing) is not currently planned until FY 90.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604233F
DOD Mission Area: 113 - Airborne Strike

Title: Tanker-Transport Training System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 0 | 4,500 | 6,017 | 10,517 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Tanker-Transport Training System (TTTS) is required to implement Specialized Undergraduate Pilot Training (SUPT) in Air Training Command. This HQ USAF approved training concept will provide a higher quality graduate with more flying hours and skills specifically tailored to the needs of gaining commands. Additionally, it will reduce training costs and displace approximately 200 T-38s. This acquisition of the Tanker-Transport (TT) aircraft will provide a substantial cost avoidance when the more expensive T-38 fleet is replaced. The TT aircraft will be a commercially available jet aircraft which will accommodate an instructor and two students. This program also provides for the procurement of simulators for the TT track. Under SUPT, students will enter either the TT track or the Bomber-Fighter (BF) track after 85 hours in the T-37 aircraft. The TT syllabus will include training in high and low altitude instrument approaches, crew coordination, asymmetric thrust situations, low-level navigation, airdrop fundamentals, airborne rendezvous, and cell formation.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands) Not Applicable

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement (PE 0804741F) | | | | | |
| Funds | 0 | 0 | 9,563 | 1,481,633 | 1,491,196 |
| Quantity | 0 | 0 | 1 | 210 | 211 |

5. (U) RELATED ACTIVITIES: Not Applicable.

6. (U) WORK PERFORMED BY: Air Force Systems Command's System Program Office at Aeronautical Systems Divsion, Wright-Patterson Air Force Base OH. Prime Contractor has not been determined/no contract awarded.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: PE 0604233F, Tanker-Transport Training System

Program Element : 0604233F
DOD Mission Area: 113 - Airborne Strike

Title: Tanker-Transport Training System
Budget Activity: 4 - Tactical Programs

A. (U) Project Description: This project develops and acquires a new trainer aircraft and training system for use in implementing Specialized Undergraduate Pilot Training in the Air Training Command. The aircraft will be an "off-the-shelf" business jet requiring minimum modifications, to include a take-off and landing stressed jump seat and ultra-high frequency (UHF) radio, to meet training needs. In addition to aircraft, the system will include simulators and curriculum courseware development to support Specialized Undergraduate Pilot Training (SUPT).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable

(2) (U) FY 1988 Program: Not Applicable

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Assuming approval of the Air Force Undergraduate Pilot Training Roadmap, FY 1989 RDT&E funds will be used to determine and perform necessary redesign to match selected aircraft with training requirements, design needed avionics integration changes, determine and perform necessary modification on selected simulator for training requirements, and begin curriculum and courseware development for the training system and its integration into the pilot training environment.

(4) (U) Program to Completion: Final RDT&E funding increments for TTTS will be used for completion of the missionization of selected aircraft, integration of simulator systems, and final curriculum development.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Issue PMD (Currently Being Revised) | 2 Jun 87 |
| (2) (U) Front End Analysis Contract Award | 29 Jan 88 |
| (3) (U) Issue RFP | Pending Funding Approval |
| (4) (U) Acquisition Contract Award | RFP + 120 days |
| (5) (U) First Aircraft Delivery | FY 1990/3 |
| (6) (U) Initial Operational Capability | FY 1992/1 |

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RT&E DESCRIPTIVE SUMMARY

Program Element: 0604236F
DOD Mission Area: 221 - Counter Air

Title: Infrared Search and Track System (IRSTS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 24,303 | 14,000 | 4,872 | 2,458 | 55,851 |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a joint Air Force and Navy development program of an infrared search and track system (IRSTS).

Supporting requirement documents include Air Defense Tactical Air Command (ADTAC) Statement of Need (SON) 10-70 (revalidated July 1983), Tactical Air Force (TAF) SON 304-83, Advanced Tactical Fighter/Air-to-Air, (validated November 1984) and TAF SON 308-84 for Fighter/Interceptor IRSTS (in final validation). The nonradiating IRSTS complements the radar and expands the aircraft's capability by increasing the detection range of high altitude or low radar cross section (RCS) targets and by allowing earlier raid cell assessment.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 31,237 | 14,055 | 4,876 | 2,458 | 62,844 |

EXPLANATION: (U) FY 87 funding reduced due to program restructure (see paragraph 5).

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This is a Joint Air Force/Navy development program. Flight test of the Advanced Demonstration Model by two contractors was completed in November 1985. Due to the Air Force's decision not to proceed into a F-15 Full Scale Development (FSD) but to continue with an advanced development program, a program restructure was required. A Memorandum of Agreement (MOA) was signed on 22 July 1986 at the Assistant Secretary of the Air Force and Navy levels for a restructured joint development program. Under this program, the Navy and Air Force will share costs in a joint technology improvement effort to include improvements in the midwave system and the development of a longwave system. The Navy will fully fund an F-14D IRSTS FSD program. The data obtained from PE 0604236F will directly support the Advanced Tactical Fighter (ATF) program, PE 0603230F, by providing the technology base for defining ATF development/operational requirements for an IRSTS.

6. (U) WORK PERFORMED BY: The advanced development work is being performed by General Electric Company, Aerospace Electronics Systems Department, Utica, N.Y.. The IRSTS FSD Request for Proposals was released in 4th Qtr FY 1985 as a full and open competition effort. Only GE responded with submission of technical and cost proposals. A contract modification was distributed to GE in May 1986 to continue advanced development. A new contract award to GE for continued technology improvement to midwave system, development of a longwave system and F-14D FSD is planned for 2nd Qtr FY 1987. McDonnell Aircraft Company, St. Louis, MO will be the associate contractor for F-15 flight test integration of the improved system while Grumman Aircraft Company, Long Island, N.Y. will be the prime contractor with the Navy for F-14D integration. Air Force Systems Command Aeronautical Systems Division is the Air Force Agency in charge of this program.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604236F, Infrared Search and Track System (IRSTS)

A. (U) Project Description: This is a joint development program for a fighter IRSTS program. The IRSTS technology is also applicable to the USAF Advanced Tactical Fighter (ATF) and the Navy Advanced Tactical Aircraft (ATA). See paragraph 2 for additional information.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Conducted Critical Design Reviews. Conducted ground laboratory testing to prove out optical improvements to the Advanced Development Model (ADM). Developed clutter rejection algorithms, focal plane arrays, and cryogenic cooling. Began fabrication of four test units for full up demonstration validation testing of both improved electronics and software. Designed and fabricated detectors for a longwave system. Continued atmospheric and signature studies.

(2) (U) FY 1988 Program: Begin flight tests of improved ADMs on an integrated pod with the F-15A test bed and provide test results to develop the data base for Advanced Tactical Fighter IRSTS sensor suites. Perform full-up demonstration and validation flight testing of improved test units on F-14A test bed. Two units will be delivered to the Navy for F-14D integration and airframe compatibility checkout. Begin fabrication of the longwave system.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete demonstration and validation flight testing of improved midwave units. Flight testing will begin on the longwave system.

(4) (U) Program to Completion: Complete development and flight testing of the longwave IRSTS units. The Air Force will make a decision on IRSTS incorporation on specific airframes following a review of the IRSTS performance during the demonstration and validation phase. The Navy will incorporate the IRSTS into the F-14D production line.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Preliminary Design Review (PRD) | | August 1986 |
| (2) (U) Critical Design Review (CDR) | | 2nd Quarter FY 1987 |
| (3) (U) Improved Optics Flight Test | *(4th Quarter FY 1987) | 1st Quarter FY 1988 |
| (4) (U) Navy Integration Model Delivery | | March 1988 |
| (5) (U) First Flight Full-up Demonstration/Validation | | June 1988 |

*Date presented in FY 1988/1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(3) (U) Flight test start slipped 5 months due to availability of F-15 test aircraft.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604237F
DOD Mission Area: 221 - Counter Air

Title: Variable Stability In-Flight Simulator Test Aircraft
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 5,816 | 6,225 | 11,869 | 16,400 | 40,641 |
| 3308 | Variable Stability In-Flight Simulator Test Aircraft (VISTA) | 5,816 | 6,225 | 11,869 | 16,400 | 40,641 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops a high-performance fighter in-flight simulator as a replacement for the NT-33A. For the past 30 years the R&D flight test community (Air Force, Navy, National Aeronautics and Space Administration, industry) has extensively employed the variable stability NT-33A for pre-first flight analysis of modern fighters, to establish flying quality specification criteria, and as a flying laboratory for control/display elements. The NT-33A has been a veritable workhorse with a full schedule of test activities. Its success is directly attributable to its relatively low cost of operation, rapid response to customer needs, and high degree of credibility in the flight test community. However, the NT-33A performance (41 year old aircraft design) is no longer representative of future fighter performance and must be replaced by the Variable Stability In-Flight Simulator Aircraft (VISTA), a modified F-16D. VISTA will identify crucial flight control and human factor design deficiencies for correction before final design review of weapon systems. The NT-33A has been credited with identification of flight control deficiencies on both the YF-17 and F-18 aircraft, which likely would have resulted in loss of these aircraft had the defects not been corrected prior to first flight. With VISTA, the Air Force and Navy Test Pilot Schools will train test pilots to identify flying quality, avionics system, and human factor deficiencies/characteristics in a realistic high performance environment. VISTA will serve as a national facility for Air Force, Navy, NASA, industry, and international flying research.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 7,733 | 6,249 | 14,380 | 8,914 | 37,607 |

EXPLANATION: The decrease in FY 1987 and the increase in Total Estimated Cost are due to alterations in program structure based on refined planning and cost estimates to field a single VISTA with minimum initial capability, but retaining the potential for upgrade. The decrease in FY 1989 accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This program receives technology inputs from Aerospace Flight Dynamics (PE 0602201F). In turn, the technology product of this program will be applied to Flight Vehicle Technology (PE 0603205F) and Advanced Flight Technology Integration (PE 0603245F). Coordination and avoidance of duplication of effort with other Air Force organizations, the Army, the Navy, and the National Aeronautics and Space Administration is accomplished through exchange of information, coordinating and advisory groups, and program reviews.

6. (U) WORK PERFORMED BY: The program is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Contractor(s) for the program will be competitively selected in the second quarter of FY 1988.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3308, Variable Stability In-Flight Simulator Test Aircraft (VISTA)

A. (U) Project Description: An F-16D fighter will be modified with variable stability controls to perform flight research in flying qualities, flight control, and avionics technology. A conceptual design study was initiated as a laboratory effort in FY 1982 and completed in FY 1986. Technical design and cost trade-off (acquisition and life cycle) studies were performed for candidate aircraft. To ensure that the VISTA meets the needs of all the users, a steering group of Air Force, Navy, and National Aeronautics and Space Administration users was formed to review and establish program requirements. Based upon long experience with in-flight simulators, the VISTA project is technically a low risk program. A proven F-16D airframe will be modified. Components (computers, sensors, servos, etc.) for the variable stability controls are readily available off-the-shelf or can easily be modified to satisfy requirements. The digital fly-by-wire technologies involved have been validated in the Advanced Flight Technology Integration (AFTI)/F-16, the X-29, and F-18.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The production-line modifications for the F-16D were selected, and production of the specific F-16D airframe was initiated. A series of design studies addressed technical issues associated with modifying the F-16D for the VISTA flight control system interfaces, display and control locations, and safety-of-flight. A formal program cost estimate was completed. The acquisition plan was approved and the request for proposals to incorporate the VISTA-unique modifications in the F-16D was released.

(2) (U) FY 1988 Program: The contract to modify the F-16D will be awarded. Detailed design of the hydraulic and electrical system modifications required to accommodate the variable stability system (VSS) operation will be conducted. VISTA's unique instrumentation (sensors, data recording systems, etc.) and the extensive cockpit modifications will be designed. Integration of the VSS with the F-16D flight control system will be designed. Production of the host F-16D will be completed to a subassembly state, ready for the incorporation of VISTA-unique modifications.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Extensive aircraft modification activity will be conducted throughout FY 1989. Hydraulic and electrical systems will be fabricated and/or reworked, front cockpit variable feel controls installed, and rear cockpit (safety pilot position) reconfigured. The variable stability system (VSS) hardware and software development will be initiated. The VSS components will be installed and integrated with the F-16D flight control system.

(4) (U) Program to Completion: Aircraft modification and VSS development activities will be completed. Extensive ground testing and analysis will be conducted to ensure that design and safety requirements have been met. A flight test program will be conducted to verify system operational performance. Completion of flight test and transition of the VISTA/F-16D to flight research programs is planned for FY 1991.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Request for Proposal | *(3rd Quarter FY 1987) | 4th Quarter FY 1987 |
| (2) | (U) | Source Selection Completed | *(4th Quarter FY 1987) | 2nd Quarter FY 1988 |
| (3) | (U) | Award Contract | *(1st Quarter FY 1988) | 3rd Quarter FY 1988 |
| (4) | (U) | System Design Completed | *(4th Quarter FY 1988) | 2nd Quarter FY 1989 |
| (5) | (U) | Aircraft Modification Completed | *(4th Quarter FY 1989) | 2nd Quarter FY 1990 |
| (6) | (U) | Ground Check-out Completed | *(1st Quarter FY 1990) | 4th Quarter FY 1990 |
| (7) | (U) | First Flight | *(2nd Quarter FY 1990) | 4th Quarter FY 1990 |
| (8) | (U) | Flight Test and Certification Completed | *(4th Quarter FY 1990) | 2nd Quarter FY 1991 |
| (9) | (U) | Transition to Flight Research Program | *(4th Quarter FY 1990) | 2nd Quarter FY 1991 |

* Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes

(1-9) Delays in procurement activities, necessitated by additional technical negotiation of program content following proposal evaluation, resulted in slippage in source selection and contract award dates.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604247F
DOD Mission Area: 225 - Air Warfare Support

Title: Modular Automatic Test Equipment (MATE)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | 18,159 | 14,942 | 13,289 | Continuing | N/A |
| 2503 MATE | 18,159 | 14,942 | 13,289 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Previous and current methods used to specify, design, build and support automatic test systems (ATS) have resulted in a proliferation of equipment, low operational reliability and supportability, and increased life cycle costs. A major reason why aircraft availability (force readiness) is below desired levels is because of malfunctioning or unsuitable ATS at all organizational levels. The MATE program has developed a set of guides which delineate a standard architecture and a management system for ATS and established a framework for the acquisition and support of future Air Force ATS. In addition, a government owned MATE Operations Center will be developed to manage the MATE developed hardware and software standards, as well as perform verification testing on proposed MATE modules.

3. (U) COMPARISON WITH FY 1988/FY1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 19,184 | 18,373 | 16,302 | Continuing | N/A |

EXPLANATION: (U) The $1.025 million decrease in FY 1987 is due to reprogramming funds to higher priority requirement (ATF). The $3.431 million decrease in FY 1988 is due to congressional cut by the Senate Armed Services Committee. The $3.013 million decrease in FY 1989 is due to higher priority requirements. These reductions will require re-negotiation and reduction/elimination of engineering change proposal with Unisys Corporation to improve MATE control & support software to reduce excessive test and fault isolation times. In addition, the Ada software conversion option cannot be exercised in FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: To prevent duplication, all cognizant Army, Navy and Air Force organizations are supplying inputs to reviews of the MATE program and guides. The MATE Program Office supports the Joint Logistics Commanders (JLC) Panel on Automatic Testing as funds and personnel permit. The Army and Navy continuously evaluate MATE products for inclusion in their ATS via the JLC Panel. The Navy developed built-in test design guides, and the fault isolation/fault

detection work being done at the Air Force Rome Air Development Center will provide a basis for decisions concerning the partitioning of test functions between the ATS and built-in test equipment. The Navy has developed, in conjunction with the Army and Air Force, the military standard on testability used in the MATE program, "Testability Program for Electronic Systems and Equipment." An industry MATE Users Group (MUG) was formed as a subgroup of the Automatic Testing Committee of the National Security Industrial Association (NSIA) to provide a wide forum and feedback for MATE progress and policy. Program Element (PE) 0207131F, A-10 Squadrons provided funds for procurement of up to 27 intermediate automatic test system (IATS) stations for the A-10 inertial navigation system (INS). The IATS is the first application of MATE to intermediate-level automatic test systems (ATS).

6. (U) WORK PERFORMED BY: This program is being implemented by the Support Equipment Systems Program Office of the Aeronautical Systems Division at Wright-Patterson AFB, OH. Supporting laboratories are the Air Force Avionics Laboratory, located at Wright-Patterson AFB, OH, and the Rome Air Development Center at Griffiss AFB, NY. The system definition contractors were the Sperry Corporation, Great Neck, Long Island, NY; Westinghouse Electric Co., Hunt Valley, MD; Technology Development Corporation, Arlington, TX; and the Emerson Electric Co., St. Louis, MO. The MATE Operations Center is managed by the Directorate of Material Management of the San Antonio Air Logistics Center at Kelly AFB, TX.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2503, MATE

A. (U) Project Description: Implementation and use of the MATE system as defined in the MATE guides will result in the design and production of ATS which meet Air Force readiness requirements. The MATE system assures adequate support for our forces in a more cost effective manner and, at the same time, provides for standardized interfaces, simplifies the support of ATS and controls proliferation of test system hardware and software. The first applications of the MATE system were the IATS for the A-10 INS and the Depot Automatic Test System for Avionics (DATSA). The acquisition of these automatic test systems was supported as part of the MATE full scale development program; these systems were developed using non-MATE funds. While the framework (manuals, specifications, guides and tools) for future ATS have been developed as a baseline to meet today's needs, continued development and enhancement of the MATE architecture is necessary to include other ATS application areas, prevent technical obsolescence, and allow all new ATS to be supported from a common base of logistics and engineering resources. New technologies to be included in the MATE guides and standards include: electro-optics, radio frequency, the Ada language, Very High Speed Integrated Circuits (VHSIC), pin electronics, flightline mobile "suitcase" testers, fiber optics, hydraulics, and pneumatics. The MATE system also has a continuing need for an organic capability to support and distribute the MATE developed products (i.e., ATE guides, standards, acquisition tools, and standard software); perform MATE module verification testing; train all levels of acquisition managers in MATE acquisition and support procedures; provide technical support to ATS acquisition programs; and test new ATS technologies. As new technologies are infused into the MATE program, they must be supported by the MATE Operations Center. The establishment of the organic MATE Operations Center will provide the Air Force with positive/absolute control of the MATE developed products and standards and enhance corporate memory,

program viability, and continuity. These efforts, currently being performed by an independent contractor, can foster greater competition and avoid potential proprietary rights conflicts if done by the Air Force.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: This project continued the development of MATE by incorporating software enhancements into the operating system and ATLAS compiler, and developing/refining standards to apply advanced technologies to automatic test system (ATS) acquisitions. New technologies investigated in earlier phases (e.g., VHSIC) will begin to be implemented and integrated into the MATE standards and interfaces. The investigation to convert the MATE Control and Support Software (MCSS) to ADA from JOVIAL will begin. Support to the Joint Logistics Commanders (JLC) Panel on Automatic Testing and the Institute of Electrical and Electronic Engineers (IEEE) ATLAS standards will continue. Initial Operational Capability (IOC) of the module verification station at the MATE Operations Center will be achieved. Lease of the contractor owned MATE module verification facility will continue to clear the backlog of candidate modules awaiting verification testing. Development of equipment to perform the other functions of the MATE Operations Center (e.g., support of the MCSS and the automated acquisition tools) continued.

(2) (U) FY 1988 Program: This project will implement and expand the development of MATE by incorporating software enhancements into the control and support software and ATLAS compiler. The MATE guides will be further developed by refining standards that apply advanced technologies to ATS acquisitions. Restructure of the MATE guides into a more usable format will begin. New technologies (e.g., fiber optics, p[illegible] electronics) investigated in earlier phases will be integrated into the standards and interfaces. The conversion to Ada software will begin. The identified VHSIC insertion candidates will be supported as well as other new technologies. The MATE Operations Center will achieve full operational capability for the verification of hardware and software modules and to support the system software, ATLAS compiler, acquisition tools, and quality assurance tools. Lease of the contractor owned MATE module verification facility will continue in order to clear the backlog of modules awaiting verification testing. The UUT Simulator will be completed and become available for use in development and testing of software test programs. Support to the Joint Logistics Commanders (JLC) Panel on Automatic Testing and the Institute of Electrical and Electronic Engineers (IEEE) ATLAS standards will continue. Cost estimates for this project are at Level II, Mature, and are based on program office experience and priced contractor agreements. Cost estimate reviewed October 1987.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This project will complete the restructure of the MATE guides into a more usable format for program offices and industry. Initial Very High Speed Integrated Circuits (VHSIC) standards will be incorporated into the MATE guides. The MCSS will be updated to incorporate enhancements such as real time test capability to provide continuing support to new ATS developments. Computer standards and MATE interface standards will be upgraded and refined to incorporate advanced avionics and test technology. Standards and software for "suitcase" testers will be developed. Newly developed products and technologies will be transferred to the MATE Operations Center for ongoing support of Air Force programs. Support to the Joint Logistics Commanders (JLC) Panel on Automatic Testing and the Institute of Electrical and Electronic Engineers (IEEE) ATLAS standards will continue. Cost estimate is category II, Mature, based on firm integrating contractor prices for full scale development tasks. Cost estimate reviewed October 1987.

(4) (U) Program to Completion: This is a continuing effort to develop, implement and support new automatic test system (ATS) technologies (e.g., fiber optics) to keep the MATE concepts and standards abreast of the ATS support requirements of future Air Force weapon systems; this includes technology areas such as pin electronics, flight-line mobile "suitcase" testers, fiber optics, hydraulics and pneumatics. Conversion of MATE software from JOVIAL to Ada will continue.

C. (U) Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| (1) | (U) | MATE Full Scale Development Phase I Completed | September 1985 |
| (2) | (U) | A-10 IATS Operational Test and Evaluation Completed | September 1986 |
| (3) | (U) | MATE Operations Center Full Operational Capability | December 1987 |
| (4) | (U) | MATE VHSIC Standard Completed | 4th Quarter FY 1987 |
| (5) | (U) | Restructured MATE Guides Completed | 4th Quarter FY 1988 |
| (6) | (U) | Unit Under Test (UUT) Simulator Completed | 4th Quarter FY 1988 |
| (7) | (U) | MATE Pin Electronics Standard Completed | 4th Quarter FY 1988 |
| (8) | (U) | MATE Fiber Optics Standard Completed | FY 1989 |
| (9) | (U) | Ada Conversion Completed | FY 1991 |
| (10) | (U) | Update and Enhance MATE Architecture | Ongoing |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604249F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Night/Precision Attack
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 37,942 | 19,774 | 4,684 | 5,056 | 528,893 |
| 2693 | Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) | 37,942 | 19,774 | 4,684 | 5,056 | 528,893 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The LANTIRN program includes development and testing of a wide angle raster Head-Up Display, a navigation pod, and a targeting pod. The navigation pod contains a terrain following radar and a fixed forward looking infrared (FLIR) sensor; the targeting pod contains a gimballed FLIR, a laser designator, an automatic tracker, a missile boresight correlator, and growth provisions for an automatic target recognizer. The need for LANTIRN is documented in Tactical Air Forces' Statement of Operational Need 302-81, Night Attack Capabilities. LANTIRN responds to that need by providing the capability to conduct close air support and interdiction missions at night and under the weather for F-15E and F-16C/D fighter aircraft. The threat by the enemy's formidable armored and air forces, especially that of the Warsaw Pact against the North Atlantic Treaty Organization (NATO), has increased in the past few years and is projected to become stronger in both quantitative and qualitative terms. Enemy armor, equipped with night vision and accurate laser ranging systems, has been combined with new hardware, training and operational doctrine to assure a continued thrust during night and adverse weather conditions. Successful interdiction and close air support missions against this threat require low altitude navigation, standoff target acquisition and accurate weapons delivery against small mobile targets as well as fixed targets. LANTIRN provides the capability not only to attack at night, but also to attack with precision laser guided weapons day or night and in conditions of limited visibility.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 38,766 | 19,851 | 4,689 | 5,056 | 529,799 |
| Aircraft Procurement | 791,100 | 797,300 | 724,700 | 745,800 | 3,578,800 |

EXPLANATION: (U) Procurement: The $10.5 million increase in FY 1987 reflects an increase in the initial spares buy. The $4.6 million increase in FY 1988 reflects a $2.5 million reduction in initial spares and a $7.1 million increase to fund the eye-safe laser training enhancement.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds (PE 0207249F) | 801,600 | 801,900 | 724,700 | 745,800 | 3,593,900 |
| Navigation Pods (Qty) | 143 | 169 | 240 | 139 | 700 |
| Targeting Pods (Qty) | 7 | 81 | 231 | 379 | 700 |

5. (U) RELATED ACTIVITIES: Aircraft production changes to support LANTIRN/F-16 integration are funded under PE 0207133F, F-16 Squadrons. Aircraft production changes to support LANTIRN/F-15E integration are funded under PE 0207134F, F-15E Squadrons.

6. (U) WORK PERFORMED BY: The LANTIRN program office, Aeronautical Systems Division, is located at Wright-Patterson AFB OH. The LANTIRN prime contractor is Martin Marietta, Orlando FL. Major subcontractors include Texas Instruments, Dallas TX, for terrain following radar; Hughes Aircraft Corp., Canoga Park CA, for missile boresight correlator; Delco Electronics, Milwaukee WI, for Military Standard 1750 pod control computers; Sperry Systems Management, Great Neck NY, for pod automatic test support equipment; and Grumman Aerospace Corp., Long Island, NY for portions of the radar support equipment. The head-up display prime contractor is GEC Avionics, Rochester, England. F-16/LANTIRN integration work is being performed by the General Dynamics Corp., Ft. Worth TX. F-15E/LANTIRN integration work is being performed by the McDonnell Douglas Corp., St. Louis MO.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2693, Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)

A. (U) Project Description: LANTIRN will provide a capability for low altitude precision attack during night and in conditions of limited visibility for air-to-surface interdiction and close air support missions. LANTIRN consists of a navigation pod, a targeting pod, and associated integration with aircraft heads-up and heads-down displays.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: LANTIRN/F-15E integration continued and flight testing began. Automatic Terrain Avoidance (ATA) integration with the F-16 continued. LANTIRN/F-16 Follow-on Operational Test and Evaluation (FOT&E) was completed in July 1987. An Air Force Systems Acquisition Review Council (AFSARC) IIIB for the navigation pod held in October 1986 approved full rate production of 143 navigation pods and continued production of 7 targeting pods and 6 sets of intermediate level support equipment. The first two production navigation pods were delivered.

(2) (U) FY 1988 Program: This project continues F-16/Automatic Terrain Avoidance (ATA) integration and development flight testing of both F-16/ATA and the LANTIRN/F-15E. Production continues for a buy of 169 navigation pods, 81 targeting pods and 12 sets of intermediate level support equipment (SE). The first 2 production targeting pods will be delivered this year. Development of the intermediate level SE will be completed. Cost estimates for this program are Category I, Comprehensive, and result from firm fixed-price production options and independent cost analyses. The latest independent cost review was conducted in September 1987 in support of the Air Force Systems Acquisition Review Council (AFSARC) milestone review.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This project will complete integration and development flight testing of LANTIRN/F-15E and LANTIRN/ATA. Production will continue and buy 240 navigation pods, 231 targeting pods, and the last 7 sets of intermediate level SE. Navigation pod Initial Operational Capability will be achieved. An AFSARC IIIB, full rate production decision for the targeting pod is planned for October 1988.

(4) (U) Program to Completion: This project will continue production of both navigation and targeting pods through FY 1991.

C. (U) Major Milestones:

| | Milestones | | Dates |
|---|---|---|---|
| (1) (U) | Basic Contract Award | | September 1980 |
| (2) (U) | Critical Design Reviews Completed | | June 1982 |
| (3) (U) | Start Navigation Pod Development Test & Evaluation (DT&E) Flight Test | | July 1983 |
| (4) (U) | Start Targeting Pod DT&E | | October 1983 |
| (5) (U) | Navigation Pod Initial Operational Test & Evaluation (IOT&E) Completed | | November 1984 |
| (6) (U) | Navigation Pod Low-Rate Production Decision (AFSARC IIIA) | | March 1985 |
| (7) (U) | Targeting Pod IOT&E | | January-April 1986 |
| (8) (U) | Targeting Pod Low-Rate Production Decision (AFSARC IIIA) | | June 1986 |
| (9) (U) | F-15E Integration Start | | April 1986 |
| (10) (U) | Navigation Pod Full-Rate Production Decision (AFSARC IIIB) | | November 1986 |
| (11) (U) | F-15E/LANTIRN Flight Test Start | | December 1986 |
| (12) (U) | First Navigation Pod Production Delivery | *(April 1987) | March 1987 |
| (13) (U) | First Targeting Pod Production Delivery | | July 1988 |
| (14) (U) | Targeting Pod Full-Rate Production Decision (AFSARC IIIB) | *(September 1987) | October 1988 |
| (15) (U) | Navigation Pod Initial Operational Capability | | FY 1989 |
| (16) (U) | Targeting Pod Initial Operational Capability | | FY 1990 |

*Date presented in FY 1988/FY 1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(12) (U) The first production navigation pod was delivered one month ahead of schedule.
(14) (U) Targeting pod full-rate production decision was rescheduled from September 1987 to October 1988 to allow assessment of the status of F-15E integration and weapons testing prior to approval of the FY 1989 buy of 231 targeting pods. The Air Force Systems Acquisition Review Council (AFSARC) approved continued low rate production of the FY 1988 buy of 81 targeting pods.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604250F
DOD Mission Area: 221 - Counterair

Title: Integrated Electronic Warfare/ Communications Navigation Identification (EW/CNI) Development
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 7,684 | 88,295 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This FY 1988 program is an advanced avionics program with specific application to the Advanced Tactical Fighter (ATF), the Army Lightweight Helicopter Family (LHX) and other low observable platforms. This program advances the results of the INEWS/ICNIA program funded in PE 0603109F to develop and test common core elements for multi-platform application. The INEWS/ ICNIA program emphasize a system architecture made up of advanced semi-conductor technology including insertion of Very High Speed Integrated Circuits (VHSIC) into communication, navigation, identification and electronic warfare subsystems. INEWS/ICNIA systems should provide a very high mission reliability, fault tolerant design, reduction in support costs and reduction in aircrew workload in a dense threat environment. The reliability and maintainability will be enhanced through the development of modular packaging techniques, portions of which will be developed for test flights on tactical aircraft.

Further, by integrating INEWS/ICNIA with the offensive avionics package, the pilot's situation awareness and combat capability will be increased.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 0 | 5,714 | 36,081 | Continuing | N/A |

(U) FY 1988 estimate reflects Congressional additions. The FY 1989 increase, due to Air Force TOA adjustments, is to insure INEWS/ICNIA meet the ATF schedule. Specifically, it accelerates INEWS, adds software tasks to ICNIA, and funds the Joint COMSEC work. An additional $2 millon OSD directed reduction in FY89 occurred to fund the universal modem program

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 0603109F, INEWS/ICNIA, will provide the support technology base for this program. Also, PE 0603226F, DOD common programming language (ADA) Advanced Development and PE 0603728F, Advanced Computer Technology will provide ADA software support products. PE 0603743F, Electronic Combat Technology interfaces advanced electronic countermeasures techniques. Close coordination with the Defense Advanced Research Projects Administration (DARPA)

sponsored Pilot's Associate program is required so expert systems technology can be used to reduce pilot workload. This program element is intended to provide a bridge between finishing advanced development work and starting the ATF FSD effort in 1991. After the ATF begins FSD this program will fund spin-offs of ATF developed technology for other tri-service applications.

6. (U) WORK PERFORMED BY: Aeronautical Systems Division at Wright-Patterson Air Force Base, Ohio, is responsible for the INEWS/ICNIA program. Two contractor Joint Venture Teams (TRW/Westinghouse and Sanders/GE) have been selected to conduct the Phase 1B, Pre-Full Scale Development program for INEWS. The ICNIA advanced development program is contracted to TRW. The Integrated COMSEC modules will be developed by NSA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0604250F, Integrated EW/CNI Development

A. Project Description: INEWS is an Air Force led, joint AF/Navy program to develop the next generation airborne defensive avionics system for advanced technology aircraft, specifically the Air Force Advanced Tactical Fighter (ATF) and the Navy Advanced Tactical Aircraft (ATA), and the Army LHX. ICNIA is a tri-service program to develop the next generation Communication, Navigation, and Identification integrated subsystem for advanced aircraft. INEWS is an integrated defensive system, (integrated with other on-board weapons system) that will enable the host aircraft to perform combat missions while operating in the advanced, multispectral netted threat environment of the 1990's.

The basic requirement is to provide aircrews timely and accurate threat warning and optimum application of countermeasures. ICNIA will provide reliable communication and navigation information to insure mission effectiveness. The response will be tailored to the specific mission requirement and projected threat environment in near real-time. Effective implementation of INEWS requires a defensive suite fully integrated with other aircraft sensors and avionics through and with an integrated avionics architecture, which includes ICNIA.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable.

(2) (U) FY 1988 Program: This FY 1988 program will emphasize hardware and software design for prime and support systems. Preliminary designs will be validated and traced to the ATF functional specifications and requirement for support systems. The program will enter FY 1988 under a preliminary Full Scale Development (FSD) phase. Preliminary FSD

will encompass contractor initiated preliminary designs of prime equipment, development of interface control documentation analyses of Common Signal Process , implementation of an avionics integrity plan, development of support equipment plan for life cycle cost analysis, initial modeling efforts, identification of critical technology risk items, development of design criteria for maintainability and reliability, recommended retrofit options and development of a Test and Evaluation Master Plan.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Pre-Full Scale Development continues and tailored platform engineering begins in FY 1989. Ground and flight testing of the integrated system will start in FY 1991. [ ] The EW/CNI system is required to interface with the offensive weapons suite without degrading required mission performance.

(4) (U) Program to Completion: A timely INEWS/ICNIA full scale development decision will be made in order to link this development effort with other subsystem avionics development as well as with the prime ATF production lines.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) Begin INEWS Pre-FSD | June 1988 |
| (2) Start ICNIA Pre-FSD | January 1989 |
| (3) Core Critical Design Review | November 1990 |
| (4) Begin ATF Full Scale Development | April 1991 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604268F
DOD Mission Area: 225 - Air Warfare Support

Title: Aircraft Engine Component Improvement Program (CIP)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 110,278 | 90,658 | 94,510 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: CIP provides engineering support to ensure that engines continue to support current missions of host aircraft, reduce cost of ownership, improve system operational readiness (OR) and keep older engines operational. Historically, aircraft systems change missions, tactics and environments to meet changing threats. A CIP objective is to ensure engines maintain satisfactory performance under new conditions. History also shows an active CIP is an effective way to reduce the cost of engine ownership and improve system OR by improving durability, operability, reliability and maintainability (R&M), repairability, and suitability as service time accumulates and operational conditions change. CIP starts after engine development and the Air Force accepts the first production aircraft with the engine. CIP continues over the engine's life, gradually decreasing to a minimum level sufficient to keep older inventory engines operational. Typically, this low level CIP effort develops depot repair procedures. CIP addresses usage and life not covered by engine warranty and enables the Air Force to obtain improved warranties when manufacturers incorporate CIP improvements into production engines. Since changes continue throughout a system's operational life, CIP must be maintained at a level to provide the engineering support to make changes which are essential for satisfactory system performance at costs affordable to the Air Force. CIP also ensures continued improvements in engine R&M factors. This reduces the size of outyear support costs. Typically, CIP efforts reduce operations and maintenance costs by a factor greater than eighteen to one. The funds requested represent Air Force requirements only and do not include funds required from other Services or from Foreign Military Sales.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 108,774 | 101,012 | 128,737 | Continuing | N/A |

EXPLANATION: (U) The net increase in FY 1987 resulted from Air Force reprogramming for previously deferred CIP tasks. Congressional actions decreased FY 1988. FY 1989 reduction reflects new fiscal constraints. The FY 1988 and FY 1989 reductions will increase operating and support costs by $44 million annually beginning in FY 1990.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: CIP draws requisite technologies from the following programs: PE 0603202F, Aircraft Propulsion Subsystem Integration (fan and low pressure turbine); PE 0603216F, Advanced Turbine Engine Gas Generator (compressor, combustor, and high pressure turbine); PE 0604218F, Engine Model Derivative Program (additional component and engine test data); PE 0708011F, Industrial Preparedness Program (materials processing and component fabrication demonstration). The Army and the Navy have Aircraft Engine Component Improvement Programs, PE 0604268A and PE 0604268N.

6. (U) WORK PERFORMED BY: The Deputy for Propulsion at Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH manages the overall program. Engine CIPs are managed at ASD, and at the San Antonio and the Oklahoma City Air Logistics Centers. Arnold Engineering Development Center, Tullahoma, TN and the Air Force Flight Test Center, Edwards AFB, CA conduct in-house test and evaluation efforts. Contractors (and engines) include Allison Gas Turbine, Indianapolis, IN (T56, TF41); General Electric Company, Evendale, OH (J79, TF39, F101, F110) and Lynn, MA (J85, J85-21, TF34, T64, T58); Air Research (Garrett), Torrance, CA and Phoenix, AZ (T76, gas turbine engines); Pratt and Whitney Aircraft of Canada, Ltd (T400) and West Palm Beach, FL (J57, J75, TF30, TF33); Solar Turbine Inc, CA (gas turbine engines); Teledyne CAE, Toledo, OH (J69); and Williams International, Walled Lake, MI (F107, F112).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: PE 0604268F, Aircraft Engine Component Improvement Program (CIP)

A. (U) Project Description: CIP is required for each operational engine to identify and resolve potential safety of flight problems, cost avoidance and operational problems that arise during service use. CIP for each engine consists of such typical efforts as: (1) analysis and test to identify engine life limiting parts so that corrective actions can be initiated before operational use is impacted; (2) evaluation of new hardware to reduce adverse engine impacts on the environment; (3) demonstrations to review or revise maintenance actions that establish and update inspection limits and techniques for field and overhaul activities; (4) investigation of field and test failures to determine the significance and, where appropriate, generate changes on a timely basis to reduce the impact on the aircraft mission; (5) reducing maintenance and spare parts costs by developing, evaluating, qualifying and introducing repair techniques or redesigned parts; and (6) flight and ground testing of engines and components to provide immediate investigation of service revealed discrepancies and to evaluate proposed engineering changes. Return on investment, age, use, number of engines, and operational experience are factors considered in allocating resources for these efforts to a given engine CIP.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: CIP provided continuing engineering support for all engines in the Air Force operational inventory. Documented life cycle cost avoidance, a measure of reliability and maintainability improvement, exceeded $2 billion, with the majority of savings from F100, F101, F110, TF33, T56, TF39, TF34 and TF41 engines. Many repair techniques were developed to avoid depot line stoppages and to provide needed parts to the field.

(2) (U) FY 1988 Program: CIP work is continuing on engines listed below to reduce air aborts, engine related safety incidents, not-mission-capable rates, scheduled and unscheduled engine removals, maintenance man-hours, and overall engine cost.

(U) F100 (F-15, F-16): The major technical effort is to support the F100-PW-220 and the associated Automated Ground Engine Test Set program. Reliability and maintainability (R&M) improvements are continuing for the Digital Electronic Engine Control, gearbox, bearings and lube system. Effort on current F100-PW-100/-200 models is decreasing as support of the upgraded 4000 cycle Improved Life Core models of these engines increases. Some of the 50 tasks being worked are redesigned compressor variable inlet synchronizing ring, improved inlet anti-ice capabilities, high pressure compressor 5th stage disk redesign, improved life for the 3-4 stage turbine spacer, and anti-rotation of the No. 4 bearing.

(U) F101 (B-1B): To quantify F101 parts life and performance retention, CIP will continue to evaluate the durability of a production engine. Operational data will be collected and evaluated to improve the effectiveness of accelerated mission testing (AMT). A lead-the-force program will be maintained. Over 38 individual repairs have been identified as top replenishment life cycle cost drivers and they will be worked as time and funds permit. The Engine Structural Integrity Program is continuing. Over 40 tasks have been proposed such as augmentor valve redesign and improved main shaft bearing reliability.

(U) F110 (F-16): This new engine entered the Air Force inventory in a single engine fighter aircraft with initial deployment overseas. Extensive testing is continuing to identify potential problems and to verify fixes developed. The technical plan is to address service revealed deficiencies, especially those with safety of flight implications as soon as they arise. The lead-the-force and life management plans are continuing. Several R&M projects and repairs are continuing as planned.

(U) TF41 (A-7): This engine accumulates about 80,000 engine flight hours (EFH) per year. Work is continuing to improve life limited parts to reduce expensive spare parts buys and to correct problems occurring in the field. Major tasks underway are engine air seal improvements, high pressure turbine (HPT) first stage vane single crystal development and application, HPT cast bearing support redesign and low pressure turbine support inner core redesign. Effort is continuing on life limit extension testing, service repair developments, qualification of alternate approved sources and investigation, analysis and correction of service revealed deficiencies.

(U) TF30 (F-111): This engine accumulates about 200,000 EFH per year. Leading causes for unscheduled removals are compressor damage, oil leakage, compressor stalls, afterburner problems and turbine failures. The leading causes for scheduled removals are low pressure compressor (LPC) stators, high pressure compressor stators, discs and spacers, and turbine nozzle vanes. Tasks planned for this time period include diffuser case repairs and cast LPC stators. Improved life analysis and AMTs are being conducted.

(U) J79 (F-4): The J79 is one of the older engines in service with over 20 million accumulated engine flight hours (EFH). Due to the age of the engine, repairs are a major part of the J79 CIP. Work includes improving the second and third stage nozzles and the turbine frames and tube to reduce oil leakage (oil leaks are the primary cause for engine removals), redesign of the turbine shaft and a compressor rotor life update. Also a fourteenth stage spacer redesign is planned to improve safety.

(U) TF39 (C-5): Many reliability, maintainability and durability improvements have been incorporated in this engine to improve the time between overhaul from 1000 hours to 5000 hours. The maintenance plan has been changed to on-condition (i.e., "as needed") maintenance. Over 200 new engines have been procured for the C-5B program. A major thrust for CIP on this engine is to develop an on-condition-maintenance threshold sampling plan and revise it as engine usage dictates to safely extend useful life of components. The impact on engine life will also be closely monitored when operating the wing modified aircraft to maximum gross weight take-offs. Some of the tasks currently planned are stage two fan blade interlock improvements, high pressure turbine (HPT) stage one blade redesign, fan tachometer and lead redesign and solution to compressor flange erosion. Several repair tasks are also planned.

(U) TF34 (A-10): This engine accumulates over 200,000 EFH per year. There are several safety or potential safety concerns which are being addressed this year: HPT stage 2 disk failures, HPT stage 1 aft cooling plate cracking, low analytical life of the compressor load lock slot and low analytical life of low pressure turbine stage 4 disk. Additionally, work is underway to correct engine performance degradation, improve compressor wear and durability, improve hot section durability, and correct various field problems.

(U) T56 (C-130): One of the oldest engines in service, there are over 8,000 T56s in the field and the engine is still in production. The Air Force accumulates about 1.5 million EFH per year. Engine removals are driven by low power or thrust, gearbox failures, oil leakage, engine decouplings, turbine and compressor damage due to material failures and turbine nozzle failures. The technical plan calls for continued evaluation of compressor coatings for improved corrosion and erosion resistance, low cycle fatigue analysis for compressor disks and series I and II turbines, development of solutions to turbine spacer problems, gearbox internal component improvements, service revealed deficiency investigations and development of repair procedures.

(U) CIP efforts for the older engines (J57, J69, J85-8 Stage, J85-21, J57, TF33, F107, F112, T58, T64, T76, T400 and gas turbine engines) continue to concentrate on repairs and other actions necessary to maintain the operation of the fleet. Air Force funds each of these engines at $1.5 million or less. This small investment to provide the support needed to keep these systems flying and to avoid depot line stoppages will generate an estimated $106 million of life cycle cost avoidance.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Effort will be conducted on each engine to reduce air aborts, aircraft safety incidents, not-mission-capable rates, scheduled and unscheduled engine removals, maintenance man-hours, and overall costs.

(U) F100 (F-15, F-16): Reevaluation of the life of various critical parts will be accomplished based on actual operational experience to reduce logistics surprises and potentially catastrophic failures. Efforts will be directed toward developing repairs for high cost parts in the various models of the F100 engine. The redesign of the compressor variable inlet synchronizing ring and the high pressure compressor fifth stage disk will be completed and tested. There will be approximately 45 individual tasks worked for the F100 engine during this time period in addition to testing at Arnold Engineering Development Center.

(U) F101 (B-1B): During FY 1989, operating hours will continue to accumulate at a high rate. The fleet leader program will identify operational problems which require continuing engineering support. Evaluation of engine durability will continue along with the improvements introduced in FY 1987 and FY 1988. Tasks planned for this year will generate an estimated $500 million in life cycle cost (LCC) avoidance.

(U) F110 (F-16): This engine will be fully operational in FY 1989. Extensive testing will continue to identify potential future problems and to verify fixes developed for identified problems. The lead-the-force and life management programs will continue. Since the main application of this engine is in a single engine aircraft stationed overseas, it is essential that fast response to field problems be available to avoid groundings and excessive aircraft safety incidents. The CIP effort will provide the engineering necessary to achieve this support.

(U) TF41 (A-7): This engine will accumulate over 80,000 engine flight hours (EFH) in FY 1989. The lead-the-force and life limit extension programs will continue. Redesign is planned for the forward bypass duct, combustion inner heat shield, low pressure cooling air manifold and outlet guide vane bypass fairing during this period. The low pressure turbine first and second stage turbine blades and wheel redesign should be completed this year. Repair procedures will be developed as required and accelerated mission tests conducted. Planned tasks will reduce LCC by an estimated $78 million.

(U) TF30 (F-111): Over 200,000 EFH are scheduled for this engine in FY 1989. Specific tasks scheduled for this year are improvement of first and second stage vane durability on the P100 model, development of a floatwall design to reduce excessive cracking of the outer duct, and repair of the rear flange flame holder. These improvements will result in an estimated $150 million in LCC avoidance.

(U) J79 (F-4): The Air Force has over 3800 of these engines and is still accumulating around 500,000 engine hours per year. Repairs will continue to be a major emphasis in FY 1989. In addition, specific tasks such as improvement of the exhaust nozzle primary flap, improvement of the fuel nozzle, coating for the low smoke combustor, turbine sump air flow deflector and reanalysis of third stage turbine disk life will begin. At least one endurance test will be conducted to validate repairs and improved parts.

(U) TF39 (C-5): Production of the additional engines for the C-5B program will be completed in FY 1989. Development of procedures for the on-condition maintenance plan will continue. Data will be available to update parts life based on usage with the increased aircraft capability. This effort will extend over three more years. Planned tasks will generate an estimated $90 million LCC avoidance.

(U) TF34 (A-10): Performance, oil contamination, and oil leakage are the leading causes for unscheduled removal of this engine. Performance degradation, compressor wear/durability, and hot section durability will be the main areas of work. Repairs, logistics support and life management will continue to be addressed. An estimated $110 million in life cycle cost (LCC) avoidance will be realized as a result of the FY 1989 CIP effort.

(U) T56 (C-130): In FY 1989, completion of improvements to the turbine spacer, reduction gearbox internal components and evaluation of compressor coatings are planned. Low cycle fatigue analysis for compressor disks and series I & II turbines will continue. Torquemeter and safety coupling improvements will be developed along with development of repair procedures and service revealed deficiency investigations. Approximately 1450 hours of testing are planned to qualify parts, replacement vendors and repairs.

(U) CIP efforts for the remaining engines (J57, J69, J85-8 Stage, J85-21, TF33, F107, F112, T58, T64, T76, T400 and gas turbine engines) will concentrate on repairs, service revealed problems, and other actions necessary to maintain the operation of the aircraft. The Air Force funding for CIP on these engines is generally $1.5 million or less. While this is a low level of funding, it provides the support to keep these systems flying and to avoid depot line stoppages, and will generate approximately $148 million of LCC avoidance.

(4) (U) Program to Completion: A continuing program is conducted for each in-service engine. The level of funding for each engine program is derived from bottoms-up estimates of development costs required to meet each engine's specific program objectives and is reviewed by the Engine Advisory Group comprised of technical and management specialists from Air Force Logistics Command, Air Force Systems Command and Air Force Wright Aeronautical Laboratories. Annual funding increases are required beginning in FY 1990 to support the introduction of the two Increased Performance Engines (IPEs), the F100-PW-229 and the F110-GE-129. These engines will undergo a field service evaluation beginning in January 1990 (conducted under PE 0604223F), and will be be introduced into production F-15Es and F-16C/Ds in 1991.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604270F*
DOD Mission Area: 371 - Self-Protection

Title: EW Development (Consolidated PE)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | *161,114 | *142,896 | *128,672 | Continuing | N/A |
| 1627 | Simulation, Analysis and Evaluation (0604738F) | 18,214 | 15,738 | 25,573 | Continuing | N/A |
| 2066 | EF-111A Upgrade (0604220F) | 30,499 | 13,654 | 12,734 | Continuing | N/A |
| 2114 | Antenna Test Range (0604738F) | 3,800 | 2,114 | 2,099 | Continuing | N/A |
| 2272 | F-16 Protective Systems (0604739F) | 4,000 | 10,400 | 13,200 | Continuing | N/A |
| 2274 | Special Operations Aircraft Protective Systems (0604739F) | 1,800 | 1,500 | 2,000 | Continuing | N/A |
| 2462 | COMPASS CALL (0604724F) | 19,043 | 12,761 | 8,915 | Continuing | N/A |
| 2712 | ASPJ Common Development (0604737F) | 2,349 | 5,036 | 5,004 | Continuing | N/A |
| 2719 | F-16/ASPJ Development/Integration (0604737F) | 9,618 | 15,001 | 3,043 | Continuing | N/A |
| 2827 | Radar Warning Receiver for F/FB/EF-111 (0207168F) | 0 | 0 | 4,500 | Continuing | N/A |
| 2879 | Automated Reprogramming Capability (0604739F) | 7,600 | 4,000 | 4,732 | Continuing | N/A |
| 2907 | Electronic Combat Intelligence Support (0305887F) | 1,691 | 1,622 | 1,682 | Continuing | N/A |
| 3106 | A-10 Protective Systems (0604739F) | 200 | 350 | 0 | N/A | N/A |
| 3107 | Special Mission Aircraft Protective Systems (HAVE CHARCOAL) (0604738F)** | 700 | 3,886 | 15,890 | Continuing | N/A |
| 3158 | Electronic Combat Digital Evaluation System(0604739F) | 4,000 | 3,600 | 5,000 | Continuing | N/A |
| 3630 | Joint Electronic Warfare Center (0604739F) | 1,300 | 2,000 | 2,200 | Continuing | N/A |
| 3660 | Inter-Command Electronic Warfare Management Directorate (0604739F) | 200 | 1,200 | 1,500 | Continuing | N/A |
| 5615 | Strategic Protective Systems (0604738F) | 35,500 | 0 | 0 | N/A | N/A |
| 5616 | B-52 Protective Systems (0604738F) | 0 | 12,100 | 0 | Continuing | N/A |
| 5618 | F-15 Protective Systems (0604739F) | 20,600 | 20,950 | 20,600 | Continuing | N/A |
| N/A | Classified Programs | 0 | 16,984 | 0 | N/A | N/A |

* PE 0604270F did not exist prior to FY 1989. Previous year's funding was budgeted in various PEs. Funding shown in FY 1988 is included in PE 0604241F, Consolidated EW Program. Does not reflect $36,147 for technology programs (see Descriptive Summary for 0603270F). The above funding shown in the FY 1987 column is included in the various PEs shown parenthetically after the project title.

** Jointly funded between: PE 0604738F & PE 0604739F in FY 1987; PE 0604738F and PE 0604241F in FY 1988

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element consolidates all engineering development efforts related to Air Force Electronic Warfare (EW) requirements. The objectives of the Air Force EW Development program are to (1) transition advanced development technoligies to installed operational capabilities via Full-Scale Development (FSD) programs and (2) maintain and advance the intelligence base necessary to support these FSD and ultimate production programs. Technology base/advanced development efforts are funded in a separate program element, PE 0603270F, Electronic Warfare Technology.

Multiple electronic warfare program elements were consolidated by FY 1988 Authorizations and Appropriations Bills. The FY 1988 consolidation was continued in the FY 1989 Additional Budget Submission, but different programs are included in the consolidation for FY 1989. In order to preserve continuity and clarity, the original project numbers under the old (FY 1987 & prior) Program Elements (PEs) have been retained. The consolidation is different in FY 1988 & FY 1989, and the following table shows these differences:

| ORIGINAL FY 87 PE | TITLE | INCLUDED IN FY 1988 CONSOLIDATION (PE 0604241F) | INCLUDED IN FY 1989 CONSOLIDATION (PE 0604270F) |
|---|---|---|---|
| 0603742F | Combat ID Technology | X | |
| 0603749F | C3CM Advanced Systems | X | |
| 0603203F | ADV Avionics for Aerospace Vehicles | X*** | |
| 0604220F | EW Counter Response | X | X |
| 0604724F | Tactical C3CM | X | X |
| 0604737F | ASPJ | X | X |
| 0604738F | Protective Systems | X**** | X |
| 0604739F | TAC Protective Systems | X | X |
| 0305887F | Electronic Combat Intelligence Support | X | X |
| 0207168F | F-111 Self Protection | | X |
| 0603743F | EC Technology | X | |
| XXXXXXXF | Classified Programs | X | |

*** Only Project 2334 included in consolidation
**** Only Project 5615 included in consolidation

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY:

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 156,255 | 206,073 | 208,354 | Continuing | N/A |
| Aircraft Procurement | 32,400 | 15,028 | 89,911 | Continuing | N/A |
| Other Procurement | 182 | 192 | 208 | Continuing | N/A |

Program Element: 0604270F  Title: EW Development (Consolidated PE)
DOD Mission Area: 371 - Self-Protection  Budget Activity: 4 - Tactical Programs

EXPLANATION: Project 2066: FY 1987 RDT&E increased by a reprogramming action. Development slipped 30 months due to technical problem with MAGIC V computer. FY 1989 RDT&E funding was increased and FY 1989 procurement funds were removed following program delays. No other content changes. Project 2712/2719: FY 1987 increase due to accounting adjustments; FY 1988 decrease due to Congressional reduction. Project 2827: New FY 1988 RDT&E amount reflects appropriation amount. FY 1989 RDT&E and Aircraft Procurement changes reflect implementation of the restructured EC upgrade plan; funds were reallocated to other accounts supporting F/FB/EF-111 EC efforts. Aircraft Procurement amounts for FY 1988 and FY 1989 reflect restructuring following cancellation of ALQ-XXX and latest estimates of ALR-62I requirements. Project 2907: Other Procurement zeroed due to contract cancellation. Project 5615: FY 1988 and FY 1989 difference results from Congressional reductions for B-1B-related activities, resulting in All remaining FY 1987 and FY 1988 project differences are a result of requirements to fund higher priority projects. FY 1989 reductions are a result of the overall DOD budget reductions associated with the FY 1989 adjusted budget submission.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement** (Proj 2642) | | | | | |
| Funds | 32,400 | 15,028 | 18,411 | Continuing | N/A |
| Quantities (Includes various items) | | | | | |

** Includes only modification funding in PE 0207253F, COMPASS CALL, associated with development efforts.

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement (Proj 2827) | | | | | |
| Funds | 0 | 50,900 | 65,700** | 246,300 | 362,900 |
| Quantities | | (62) | (72) | (149) | (283) |

**Includes BP1900 and BP1600 funds

5. RELATED ACTIVITIES: Project 2066: PE 0207252F, EF-111A Squadrons, funds the Class V modification kit procurement and military construction associated with the EF-111A Tactical Jamming System. This program element also procures the second Operational Flight Trainer, which will be located at RAF Upper Heyford, UK. PE 0603270F, Electronic Warfare Technology, funds advanced development efforts for a high powered jamming system. PE 0702207F, Depot Maintenance, funds the installation of the EF-111A Tactical Jamming System. PE 0604227F, Flight Simulator Development, funds development of Initial Operational Flight Trainer, which will be located at Mountain Home AFB, ID. Project 2462: The Air Force production manager (Air Force Logistics Command) and development manager (Air Force Systems Command) for the EC-130H operate with a joint agreement for interface and configuration control to ensure that new equipment can be incorporated into operational use. This program builds upon technology demonstrated in PE 0603270F, Electronic Warfare Technology and provides engineering development for the production PE 0207253F, COMPASS CALL. Projects 2712/2719: The Airborne Self-Protection Jammer (ASPJ) (ALQ-165) program is structured as a joint Navy/Air Force effort with Navy funds provided under a separate Navy PE. These F-16 internal Electronic Countermeasures (ECM) efforts are directly related to PE 0207133F, F-16 Squadrons. A Memorandum of Agreement was signed by the Commander, Naval Air Systems Command; the Commander, Aeronautical

Systems Division; and the Commander, USAF Acquisition Logistics Division in July 1982, and remains the operative document covering the joint development program. The F-16 radar warning receiver program is being interfaced with the ALQ-165 to ensure compatibility. Projects 1627/2114/3107: The efforts in these projects draw heavily on concepts and technology demonstrated in the advanced development PE 0603270F (Electronic Warfare Technology), technology from other projects within this program element, PE 0604735F (Range Improvements Program), and other classified PEs. Integration/development completed in Project 3107 will be manifest in the Airlift Defensive Systems PE, currently being identified. Project 2272: Project efforts include

Project 3158: Very High Speed Integrated Circuit technology developed in PE 0603452F is applied for insertion into various defensive systems such as the F-15 Avionics/Tactical Electronic Warfare System (TEWS). This PE transitions to the F-15 (0207134F) and F-16 (0207133F) production PEs. Project 2907: This project supports Air Force Electronic Combat (EC) projects within PE 0604270F. The Electronic Warfare Intelligence Support (EWIS) provides intelligence information to self-protection EW equipment developers and other EC systems under development.

Project 2827: ECM pod procurement is proceeding from within the P-1900 account. Projects 2274, 2879, 3106, 3630, 3660, and 5618 have no activities directly related.

6. (U) WORK PERFORMED BY: Project 2066: The prime contractor for the EF-111A Upgrade program is Eaton Corporation, AIL Division, Deer Park, Long Island, NY, and the principal subcontractors are: Tasker Digital Radio Frequency Memory (DRFM). Whitaker Corp, Systems Division, Simi Valley, CA; Delco (processor), General Motors, Systems Operations, Goleta, CA; Comptek Research Inc. (software), Buffalo, NY; and General Dynamics (integration), Fort Worth, TX. The EF-111A Upgrade development effort will be managed by Aeronautical Systems Division, Wright-Patterson AFB, OH, and the installation will be accomplished by Sacramento Air Logistics Center, Sacramento, CA. Project 2462: Aeronautical Systems Division, Wright-Patterson AFB, OH, manages the program to develop improvements to the EC-130H COMPASS CALL; Air Force Logistics Command, Wright-Patterson AFB, OH manages the EC-130H modification program. The primary COMPASS CALL contractors performing work for this effort include: Lockheed Aircraft Services, Ontario, CN; Sanders Associates, Nashua, NH; and Magnavox, Fort Wayne, IN. Project 2712: ASPJ development is managed by a Navy/Air Force Joint Program Office (JPO) at the Naval Air Systems Command, Washington, DC. The Navy is the lead service. The Air Force-unique portion of this program, integration of the ASPJ into the F-16, is managed by the Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH, with assistance from Air Force Logistics Command, Wright-Patterson AFB, OH. The ASPJ Phase I design effort was accomplished by two competitive contractor teams. One ASPJ team was Northrop Corporation, Rolling Meadows, IL, and Sanders Associates, Nashua, NH. The second ASPJ team was ITT, Nutley, NJ, and Westinghouse Corporation, Baltimore,MD. The ITT/Westinghouse Joint Venture (JV) team was selected during FY 1981 to proceed into ASPJ Phase II Full-Scale Development (FSD) of engineering development models. Project 2719: Integration of ASPJ into the F-16 is being accomplished by General Dynamics, Ft Worth, TX. Project 5616: The major contractors are the Boeing Military Airplane Company, Wichita, KS; International Telephone and Telegraph Avionics Division, Nutley, NJ; and Motorola Government Electronics Division, Scottsdale, AZ. Project 1627: The major contractor is General Dynamics Corporation, Ft. Worth, TX. Project 2114: The Air Force manager is Air Force Systems Command, Electronic Systems Division, Rome Air Development Center, Griffiss AFB, NY. Project 5618: Major contractors are

Northrop Corporation, Defense Systems Division, Rolling Meadows, IL (ALQ-135 Internal Countermeasures Set); Loral Electronic Systems, Yonkers, NY (ALR-56C RWR). Project 2274: The contractor is Raytheon Corporation, Goleta, CA (QRC 85-04). Project 2907: The Foreign Technology Division (FTD) at Wright-Patterson AFB, Ohio, performs Electronic Warfare Intelligence Support (EWIS) project tasks, using in-house and contract resources. Current EWIS data file development is being accomplished by the Planning Research Corporation (PRC) field office at Dayton, Ohio. FTD also does threat SIMVAL program tasks for new threat simulators under development. This work is assisted by radar engineers from Sverdup Technology, Inc. of Tullahoma, Tennessee. Project 2827: The Radar Warning Receiver (RWR) system is being developed by Dalmo Victor of Belmont, CA. The RWR Group B development and procurement for the F/FB-111 is managed by Warner Robins Air Logistics Center, Robins AFB, Georgia. The EF-111A portion of the RWR development will be a joint effort between Aeronautical Systems Division (ASD). Wright-Patterson AFB, Ohio and Warner-Robins. The Air Force managers for all remaining projects are Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH; and Armament Division, Eglin AFB, FL.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 2114, Antenna Test Range. This project provides for the acquisition, maintenance and continuing update of a precision Electronic Warfare (EW) antenna test range employing

The range is used during advanced and full-scale development programs to test and evaluate new EW antennas and antenna installations on board actual aircraft to determine radiation patterns. During FY 1986, Real-Time Data Reduction updates were completed, the instrumentation projects continued, and work was initiated on instrumentation for the Precision Antenna Measurement System. System isolation and range reflection measurements were taken at the Stockbridge, NY, facility. A capability to evaluate Phased-Array Antenna Systems (PAAS) was addressed. FY 1987 saw continuation of the Efforts were initiated to procure a B-1 shell, and resulted in acquisition of same. In FY 1988,

in FY 1989.

B. Project: 2274, Special Operations Aircraft Protective Systems. This project develops EW equipments which form the self-protection suites for special operations aircraft. Most tasks within this project tailor available equipment (such as Radar Warning Receivers (RWRs), infrared jammers, chaff flares and dispensers) or equipment under development in other projects within the PE (such as the ALE-47) for application to special operations aircraft. The unique, funded task within this project is to evaluate the application of a

Brassboard development was initiated in Feb 1987 to include the development of two flight qualified systems to be used for antenna pattern definition at Rome Air Development Center and flight testing to be accomplished in Feb-May 1988. Flight test results will be used to make a Full Scale Development decision in FY 1989.

C. Project: 2462, COMPASS CALL. In FY 1979, the Air Force directed an EC-130H stand-off jamming platform to be integrated into a defense-wide Command, Control, and Communications (C3) jamming capability. This airborne capability complements both present and future ground-based and sea-based systems to provide theater commanders with a

coordinated jamming capability. The EC-130H stand-off jamming platform initially used readily available equipment to provide a near-term baseline capability. Meanwhile, the portions of the C3CM package that needed development proceeded in this project. This project provides engineering development of jammers to counter or disrupt

within the enemy C3 network. This project makes major improvements to the initial EC-130H installed equipment to increase radiated power and simultaneously jam multiple threats. These pre-planned improvements are in consonance with the original acquisition strategy to correct known deficiencies in the baseline system. All improvements to the aircraft are also made to the mission simulator to provide realistic mission-aircrew training. FY 1987 accomplishments included continuation of incorporation of the signal location capability into the mission simulator. Developments for jamming power were initiated, and reliability improvements were investigated under a multifaceted Improved Intercept Countermeasures (I2CM) program. Rewrite of the baseline system software continued. During FY 1988, radio frequency distribution and antenna subsystem improvements will commence with primary emphasis on radiation directivity, power and signal handling capability, and radiation efficiency. A jamming waveform analysis will continue to ensure appropriate jamming waveforms are matched against specific threat links of interest. Concurrent with the jamming waveform analysis, an exciter subsystem design will be developed to ensure appropriate jamming (spectral and temporal) is available to counter increased numbers of signals simultaneously. Elimination of interference caused by jammers to onboard mission radios will also be initiated. In FY 1989, I2CM activities conducted during the past two fiscal years will culminate in the initiation of a full-scale system development program to include synthesizers, modulation generators, power amplifiers, radio frequency distribution and antennas. These enhancements will result in improving the COMPASS CALL system efficiency by making it capable of effectively jamming more targets simultaneously at required ranges. Since the late 1970's when COMPASS CALL was developed using off-the-shelf equipment and technology, the EC-130H has demonstrated its utility in various exercises as an important and viable countermeasure to command and control systems. Ongoing pre-planned development efforts are a directed result of the development and procurement strategy that fielded this C3CM capability and the threat that has emerged since the inception of the COMPASS CALL program. Development efforts for require special access. The cost estimates are Category III based primarily on current contract and the Air Force Systems Command Program Office experience with current, similar development programs and are current as of November 1987.

D. Project: 2712, ASPJ Common Development. This project funds the Air Force share of the joint Navy/Air Force common development of the ASPJ (ALQ-165). This development is required to increase Air Force and Navy tactical aircraft survivability and provide an enhanced probability of mission success. ALQ-165 Research, Development, Test and Evaluation (RDT&E) is required to develop advanced ECM techniques for countering existing and projected threats

Twelve ASPJ FSD Systems will be used for system effectiveness evaluations, reliability testing, Developmental Test & Evaluation qualification testing, DT&E, Initial Operational Test and Evaluation (IOT&E) and system integration. In FY 1987, ASPJ completed DT&E at the Air Force Electronic Warfare Evaluation Simulator (AFEWES) and commenced flight testing at the Electromagnetic Test Environment (EMTE) range at Eglin AFB, FL and China Lake Naval Weapons Center (NWC) CA. The result of this testing led to the award to the JV of a Production Verification (PV) contract for six ASPJ systems, to be delivered starting in FY 1989. Based on successful operational assessment in FY 1988 by the Air Force Operational Test and Evaluation Center (AFOTEC) and the Navy Operational Test and Evaluation Force (OPTEVFOR), the Air Force and Navy

will award to the JV an option for 14 more PV systems. The purpose of this PV phase is to ensure that both contractors (ITT and Westinghouse) can separately build all the "black boxes" that comprise the ASPJ system. Currently, Westinghouse only builds the receiver/processor portions, and ITT builds the transmitter/high voltage power supply portions of ASPJ. Production Verification (PV) will significantly lower the risk of both contractors being able to separately build the entire jammer. At the end of FY 1988, AFOTEC and OPTEVFOR will complete IOT&E flight testing. Successful completion of this testing will lead to a Milestone IIIA limited production decision in November 1988 for 192 ASPJ systems (136 Air Force, 56 Navy). In FY 1989, ASPJ will be integrated on an F-16C aircraft with the APG-68 radar, the Advanced Medium Range Air-to-Air Missile (AMRAAM) and Low Altitude Navigation Targeting Infrared Night (LANTIRN). Once integrated, the ASPJ system will undergo operational evaluations on the Air Force F-16C and Navy F-18 aircraft. Successful completion of these evaluations will lead to a Milestone IIIB full-rate production decision in August 1989 for 340 systems. ITT and Westinghouse will compete against each other for this and all subsequent ASPJ production buys. Additional FY 1989 efforts include Avionics Intermediate Station (AIS) software development, AIS hardware changes for depot level maintenance support and Preplanned Product Improvement (P3I) for software improvement and Very High Speed Integrated Circuit (VHSIC) insertion. Cost estimates are Category I based on an independent cost estimate reviewed by OSD in June 1986 and updated by using contractor data derived from the F-111 ECM update proposal in 1987 and Joint Venture budgetary estimates used for the PV contract award in August 1987.

E. Project 2719, F-16 ASPJ Development/Integration. This project supports unique engineering required for the integration of the ASPJ into the F-16 aircraft. This includes Group B ("black-box") development, operational testing, development of the F-16 ASPJ avionics rack, Electromagnetic Interference/Electromagnetic Compatibility (EMI/EMC) testing, F-16 software integration/development testing and Intermediate- (I-) Level and Organizational- (O-) Level test equipment hardware and software development. ASPJ software and hardware is optimized at the Pacific Missile Test Center (PMTC), and the program office conducts environmental and reliability testing at the contractor's facility. F-16 ASPJ DT&E is conducted at Eglin AFB, FL. In August 1987, the ASPJ JPO awarded a PV contract to the JV for six ASPJ systems. Upon successful testing in FY88, the services will exercise a PV option for 14 additional systems to the JV. The purpose of PV is to verify that each contractor can independently produce the ASPJ in preparation for award of the limited production contract in FY 1989. At the conclusion of Eglin DT&E in March 1988, ASPJ will undergo Operational Test and Evaluation (OT&E). The AFEWES OT&E will start concurrently with OT&E flight testing at Eglin AFB. In FY 1988, ASPJ will also complete the bulk of the 3000 hour Reliability Demonstration Test and continue F-16 integration at the System Integration Laboratory (SIL) at General Dynamics. The ASPJ will undergo extensive OT&E flight testing at the Eglin AFB EMTE range and China Lake NWC, CA in preparation for the Milestone IIIA production decision in November 1988. Hardware and software development for F-16 I- and O-level support equipment will also continue in FY 1988. In FY 1989 ASPJ will undergo Reliability Qualification Testing (RQT) to confirm that the system will perform in the F-16 flight envelope. Air Force-unique F-16C ASPJ operational flight testing will take place in FY 1989 at the flight ranges not yet exercised by the Air Force. The IIIB full-rate production decision is planned for FY 1989. The development product improvement program will also begin in FY 1989 and continue through FY 1994. This will be a common development between the Air Force and Navy with common "black boxes" developed for all aircraft scheduled to acquire this ASPJ pre-amplifier development for sensitivity improvement will also begin in FY 1988. This is a continuing program. All IOT&E should complete in FY 1989 in

preparation for the IIIB full-rate production decision. The development should continue until FY 1994 along with several other ASPJ improvements, including sensitivity improvement, VHSIC insertion, second-generation Digital RF Memory (DRFM), ASPJ software improvement and advanced technology incorporation.

F. (U) Project: 2827, Radar Warning Receiver for F/FB/EF-111A. This effort incorporates the already-developed ALR-62I into the EF-111A. In FY 1987, ALR-62I preproduction deliveries (funded within the Aircraft Procurement appropriation) began. The system entered simulator and flight testing. Reliability Growth Program began. During FY 1988, ALR-62I testing will complete, and a production decision will be made. FY 1989 will result in procurement of Group B to support EF-111A integration. Development of EF-111A aircraft interfaces will start.

G. Project: 2879, Automated Reprogramming Capability (ARC). ARC will provide the using commands with the capability to rapidly respond to threat changes in hostile electronic threat environments. This will be accomplished by changing data software in a wide range of Electronic Warfare (EW) Systems and RWRs, via the ARC console. The ARC is a software intensive, computerized system that will allow the operators to assess the impact of threat parameter changes on EW systems, establish and select realistic reprogramming options for the EW system software, test the options, and create and document the changes to the EW system software programs. The ARC program updates the existing manual approach achieving a rapid and accurate response to the operational organizations. The original ARC program was placed on contract February 1984, but was determined to be unexecutable and the contract with Teledyne was terminated on 24 Mar 87. HQ Tactical Air Command, Military Airlift Command, and Strategic Air Command have reviewed and combined their requirements, and HQ Air Force System Command has submitted a restructured ARC program proposal which was approved by a AFSC/Deputy Chief of Staff Roundtable (Using, Developing, Supporting command representatives) in Nov 87. A proof of concept demonstration is being developed for the ALR-69 system. This task is expected to be on contract in FY 1988.

H. Project: 2907, Electronic Combat Intelligence Support. The USAF has a heavy investment in reprogrammable threat warning and jamming equipment to detect, display and disrupt enemy electronic emitters. This equipment is found in the majority of Air Force aircraft including EC systems such as the F-4G (WILD WEASEL) and the EF-111A.

FTD produces Intelligence Data Input Packages (IDIPs) to provide information based on the most current intelligence to designers in the form and engineering detail needed to allow systems acquisition decisions. Threat simulators are used in joint service exercises (RED FLAG and TEAM SPIRIT) and developmental/ operational test and evaluation efforts. Additionally, the Air Force Electronic Warfare Evaluation Simulator (AFEWES) uses computerized threat simulations for the test and evaluation of EC equipment. FY 1987 accomplishments included the following:

Some of the FTD-completed reports include support to these Air Force simulator projects: MSG-T13; MPS-T2; MPQ-T3A; AN/MSR-T4; and the Enhanced Surface-to-Air Missile Simulator (ESAMS) digital simulations. During FY 1988,

SIMVAL reports will be provided to the AFEWES TWS-11M/TWS-10 upgrade, the SDADS VIM/SADS XII, and the

Modular Advanced Threat Simulator. Throughout FY 1989, the EWIS and SIMVAL projects will continue to provide intelligence information to Air Force EC programs in the detail and form demanded by development engineers.

The EWIS project will continue investigating ways to validate digital simulations and produce threat models support selected EW equipment acquisition programs. SIMVAL will continue validation testing initiated in FY 1987. The EWIS project will provide IDIPs to simulator builders and the SIMVAL project will continue support to threat simulator development.

Cost estimates fall into Category IV, Planning. Level of effort is dependent on established EC intelligence support requirements. Future validation efforts will be based on operational requirements for intelligence updates, and system modifications. Work will begin to define communication systems interface requirements to enhance user access to the EWIS data base. This is a continuing program.

I. (U) Project: 3158, Electronic Combat Digital Evaluation System. This project involves the development of the Electronic Combat Digital Evaluation System (ECDES), which will transfer to PE 0604735F. Another task formulates a plan for Very High Speed Integrated Circuit (VHSIC) technology insertion into current and future RWRs and Electronic Countermeasures (ECM) systems. The goal is to use common VHSIC modules which can be applied to similar systems with different architectures. For example, it may be possible to utilize a VHSIC signal sorting module with both the ALR-56C and the ALR-69 RWR family. Similar opportunities may exist for inserting common modules into the ALQ-135 and ALQ-165 ECM systems. Aeronautical Systems Division will provide a VHSIC insertion roadmap to exploit VHSIC development under Integrated Electronic Warfare Suite/Advanced-Technology Fighter (INEWS/ATF), etc. for inclusion into F-15/16 systems.

J. Project: 3630, Joint Electronic Warfare Center (JEWC). This project identifies various Joint Chiefs of Staff-sponsored 6.2/6.3 projects within Air Force/Navy/Army labs and provides management and funds to expedite the movement of the project to 6.4 effort. Planned programs for FY 1988/89 include investigation of generic threat identifier technique which will allow tactical electronic support measure systems to identify and categorize unknown or new threat emissions; potential means of updating electronic order of battle on combat aircraft;

K. (U) Project: 3660, Inter-Command Electronic Warfare Management Directorate (ICEWMD). The objective of ICEWMD is to ensure AF airborne Electronic Warfare (EW) programs are executable through upfront planning and analysis and to integrate AFSC and AFLC development, acquisition, modification and production phases of EW programs. This project funds the development of common 'programmatic' data bases and support systems to be used to expedite the formation of various programs and to provide 'programmatic' advice throughout the program's life. Specific tasks the ICEWMD is actively involved include: Statement of Need (SON) validation and Advanced Airborne Expendable Decoy (AAED) implementation on AF aircraft.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 1627, Simulation, Analysis and Evaluation

Program Element: 0604270F*
DOD Mission Area: 371 - Self-Protection

Title: EW Development (Consolidated PE)
Budget Activity: 4 - Tactical Programs

A. Project Description: This project develops, fabricates and validates laboratory simulations of The two major simulation facilities funded by this project are the Air Force Electronic Warfare Evaluation Simulator (AFEWES) and the Real-Time Electromagnetic Digitally-Controlled Analyzer and Processor (REDCAP). These facilities provide realistic laboratory simulations of (including evaluations) to permit effective definition, design and evaluation of new/improved countermeasures equipment in precisely-controlled environments. This permits extensive testing before flight test at a fraction of flight test cost for similar efforts.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: AFEWES fabrication efforts continued on simulations. was completed, and the capability update continued. Initial efforts on simulations were undertaken. Planning for incorporation continued. Evaluation of REDCAP upgrades were made, leading to decisions to continue REDCAP as a viable test facility.

(2) FY 1988 Program: Fabrication of simulations will continue. Modification to the system completes. missile simulation will be completed as well. will complete and contracts will be let for fabrication of a simulation. Both the AFEWES and REDCAP upgrades are sole source activities that take place in government-owned/contractor-operated facilities. The funding estimates are current as of 14 December 1987.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Fabrication of simulations will be completed. interleaving with specific simulations will be accomplished for the first time. Airborne clutter simulation efforts will be initiated. Fabrication of the simulator will be started. The budget estimates are Confidence Level IV and are based on similar work that has been accomplished in the past. Funding estimates are current as of 14 December 1987.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) ( , Simulations Completed | *(1st Quarter 1987) | 3rd Quarter 1989 |
| (2) ( Contract Award | *(3rd Quarter 1987) | 3rd Quarter 1988 |
| (3) ( | | Throughout 1989 |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes

(1) (U) Delay caused by delay in determining simulation architecture investment strategy/plan.
(2) (U) Delay caused by delay in determining simulation architecture investment strategy/plan.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2066, EF-111A Upgrade

A. Project Description: Update to the EF-111A is required to keep the tactical jamming system current against the evolving threat. Since the 1974 design cut-off point for the original jamming suite,

The update program will incorporate a new multiple processing encoder, a MIL-STD 1750 computer, MIL-STD 1533B data bus, two reprogrammable exciters, and new narrow band 7/8 antenna and software changes to allow the system to defeat the threat by placing concentrated jamming through improved power management on specific radars of interest.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Test aircraft Group A modification completed. Preparation for Developmental Test & Evaluation (DT&E) continued. Hardware fabrication 95% completed. Software development 85% completed. Hardware/software integration began.

(2) (U) FY 1988 Program: Hardware/software integration continues. Also, a Band 7/8 antenna development test will be placed on contract. Program cost estimates were obtained by RCA PRICE H Model for the hardware equipment, RCA PRICE S Model for the software, and an Aeronautical Systems Division heuristic technique for total life cycle cost. Program cost category is Level IV with a confidence level of III. Cost estimate data is considered good and was validated by Independent Cost Analysis done in 1986.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Will complete type I training in preparation for DT&E. Will begin modifying Avionics Integrated Support Facility to accommodate updated ALQ-99E system. Hardware/software integration continues.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Program Element: 0604270F*
DOD Mission Area: 371 - Self-Protection

Title: EW Development (Consolidated PE)
Budget Activity: 4 - Tactical Programs

| | Milestones | | Dates |
|---|---|---|---|
| (1) | (U) Update Contract Awarded | | October 1984 |
| (2) | (U) Preliminary Design Review | | March 1985 |
| (3) | (U) Critical Design Review (Hardware) | | September 1985 |
| (4) | (U) DT&E Test Begins | | October 1990 |
| (5) | (U) Production Decision | *(December 1988) | September 1991 |
| (6) | (U) First Production Kit Deliver | *(May 1990) | January 1993 |
| (7) | (U) First Install | *(June 1990) | May 1993 |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes

(5) - (7) (U) Delayed due to technical problems with processor development.

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2272, F-16 Protective Systems

A. Project Description: This project develops EW equipment which form the F-16 self-protection suite. Specific tasks include: a project to develop ; to counter advanced surface-to-air missile and anti-aircraft artillery systems; automatic, threat adaptive ALE-47 Countermeasures Dispenser System (CMDS) to be integrated with the Airborne Self-Protection Jammer (ASPJ)/advanced RWR-equipped F-16 C/D and optical threat acquisition and countermeasures systems; advanced chaff for countering future Soviet threats. The project is developing an Onboard Electronic Warfare Simulator (OBEWS) for crewmember training.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In November 1986, the Undersecretary of Defense for Acquisition directed that the Air Force (lead) and Navy develop a Joint ALE-47 CMDS. The Air Force source selection was terminated and a new program initiated to include Air Force, Navy and Army requirements. The data package for RR-180 Dual Chaff was contract in July 1987. The OBEWS program integration continued leading to a January 1988 lab test and follow-on DT&E flight test in FY 1988.

(2) (U) FY 1988 Program: This project requires the funds to continue the ongoing efforts to support the F-16 Blk 50 development, production and deployment milestones. The AN/ALE-47 CMDS Full-Scale Development (FSD) program will begin. DT&E/IOT&E flight testing of the OBEWS is scheduled to begin in May 1988, continuing for six months. Schedule extensions are expected due to a 2-9 priority for range access.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: ALE-47 design and fabrication will continue. OBEWS flight test and data reduction will lead to an April 1989 production decision.

(4) (U) Program to Completion: The ALE-47 will continue into lab/flight test leading to a production decision. A low rate initial production decision for the ALE-47 is scheduled in Jun 1991. Deliveries begin in Feb 1992. The OBEWS will begin production in FY 1990 with modifications developed to interface with the winner of the ALR-56M/74 RWR competition for the F-16.

C. (U) Major Milestones

| Milestones | | Dates |
|---|---|---|
| (1) (U) ALE-47 Preliminary FSO Contract Award | | Sep 1983 |
| (2) (U) ALE-47 FSD and Production Contract Award | *(March 1987) | May 1988 |
| (3) (U) ALE-47 DT&E/IOT&E Flight Testing | | Feb 1991 |
| (4) (U) ALE-47 LRIP Decision | | Jun 1991 |
| (5) (U) ALE-47 Production Decision | | Dec 1991 |
| (6) (U) ALE-47 LRIP Deliveries | | Feb-Aug 1992 |
| (7) (U) ALE-47 Production Deliveries | | Aug 1992 |

*Date presented in FY 1988/FY 1989 Descriptive Summary.

(U) Explanation of Milestone Change

(2)-(7) (U) ALE-47 FSD Contract Award and remaining schedule adjustments were caused by the transition from an AF-only program to a JOINT AF/Navy/Army program.

11. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3107, Special Mission Aircraft Protective Systems (HAVE CHARCOAL):

A. Project Description: HAVE CHARCOAL has been expanded from the original, development program to a to the noncombatant aircraft threat. expansion, due to the nature of the threat, is the prime driver in this effort. This project provides for development of a common defensive architecture on tactical and strategic airlift aircraft, specifically the C-17, C-130, C-141 and C-5. This is a design-to-cost/schedule effort, and utilizes C-17 requirements and schedule is the primary driver for development. It is envisioned that could use this architecture once developed.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Previous limited-scope HAVE CHARCOAL activities were terminated in preparation for current program.

(2) (U) FY 1988 Program: Request for Proposal (RFP) release to industry is planned for FY 3/88, leading to projected contract award in FY 2/89. Due to the immediacy of the problem for tactical airlift in both peacetime and conflict environments, the C-130 will be the lead aircraft for incorporation, although all four previously-mentioned aircraft must be considered and addressed in the response in an "as common as possible" architectural and system response. Proposals will be evaluated in late FY 1988.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 will start with contract(s) award(s) for the selected team. It is anticipated that these awards will be to the selected aircraft integrator, systems integrator, and systems builders dependent upon the selected sources. Core system design, lab integration, C-130 and C-17 installation trade studies, supportability analyses, and C-130 integration and test will comprise the initial efforts in FY 1989. This will lead to final installation decisions and C-130 DT&E flight test beginning in late FY 1989. The C-130 flight test will double as a feasibility demonstration/risk reduction for C-17 flight test in FY 1991/1992, and follow-on test for C-141 and C-5 platforms in the outyears.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) RFP Release | 3rd Quarter FY 1988 |
| (2) (U) Contract Award | 2nd Quarter FY 1989 |
| (3) (U) C-130 Production Decision | 1st Quarter FY 1991 |
| (4) (U) C-17 Production Decision | 3rd Quarter FY 1992 |

12. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 5618, F-15 Protective Systems

A. Project Description: This project develops the Tactical Electronic Warfare System (TEWS) improvements and upgrades to the F-15 self-protection suite. The F-15 TEWS consists of the ALR-56A Radar Warning Receiver (RWR), the ALQ-135 Internal Countermeasures System, the ALQ-128 Electronic Warfare Warning System and the ALE-45 Counter-Measures Dispenser (CMD). Upgrades of the ALR-56A to the ALR-56C configuration, of the ALQ-135 to include Band 3/1.5 capabilities and a CMD interfaced with the RWR are required to provide effective aircrew warning and countermeasures against the threat and sophisticated surface-to-air threats. These tasks constitute an ongoing program to develop self-protection capabilities which will permit the F-15 to accomplish its combat tasking in a technologically advanced, dense threat environment.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Ground testing and development flight testing of the individual ALR-56C and ALQ-135 Quick Reaction Capability (QRC) systems began. Productionizing the ALQ-135 Band 3 hardware and development of the Band 1.5 system continued under the Preplanned Product Improvement (P3I) Program. Initial Operational Test and Evaluation (IOT&E) of the ALR-56C, ALQ-128 and ALQ-135 Band 3 TEWS suite began. F-15 test aircraft will be modified to accommodate continuing software and hardware testing of production equipment. Software updates to the ALR-56C, ALQ-135 and ALE-45 continued in response to threat parameter changes. Deliveries of the Quick Reaction Capability (QRC) ALQ-135 Band 3 systems continued. An ALQ-135 sensitivity study contract was awarded in FY 1987.

(2) FY 1988 Program: Development of both the ALR-56C and the ALQ-135 will continue. Ground and flight testing of the ALR-56 and the ALQ-135 QRC will continue. Efforts will begin to study software integration enhancements for the ALE-45. DT&E flight testing of the ALQ-135 P3I will begin. Deliveries of ALR-56C P3I will begin. An analysis of F-15 RF interoperability will continue. An effort will be initiated to determine the best, most cost effective incorporation of into the ALQ-135 update program. Phase IV F-15 TEWS integration flight testing which will include the ALE-45, ALR-56C, ALQ-128, and the ALQ-135 QRC will commence.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: ALQ-135 P3I deliveries will begin to meet F-15E Initial Operating Capability (IOC) in Oct 1989. FSD of incorporation into ALQ-135 will continue. Incorporation of enhancements for F-15 system interoperability will begin. Efforts will continue on ALE-45 enhancements. Cost estimates are category IV based on experience of the Air Force Systems Command Systems Program Office with current, similar development programs. Program costing was reviewed in June 1986.

(4) Program to Completion: This is a continuing program to develop self-protection capabilities for the F-15. The continuing program includes development of , and more extensive integration of the F-15 TEWS with other aircraft avionics, such as the fire control radar (for potential beyond-visual-range passive detection and identification), to enhance F-15 offensive capability and survivability. Efforts will begin to evaluate potential of VHSIC application in F-15E and avionics systems with potential use of artificial intelligence.

C. (U) Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| (1) | (U) | ALE-45 Countermeasures Dispenser (CMD) Development Contract Award | Jun 1978 |
| (2) | (U) | ALR-56C Radar Warning Receiver (RWR) Development Contract Award | Aug 1981 |
| (3) | (U) | ALE-45 CMD Development Test and Evaluation (DT&E) Flight Test | Dec 1981 |
| (4) | (U) | ALE-45 CMD IOT&E Flight Test | Dec 1982 |
| (5) | (U) | ALQ-135 Internal Countermeasures System (ICS) Quick Reaction Capabilities (QRC) Band 3 Development Contract Award | Feb 1983 |
| (6) | (U) | ALQ-135 ICS QRC Band 3 Ground Test | Nov 1983 |

Program Element: 0604270F*
DOD Mission Area: 371 - Self-Protection

Title: EW Development (Consolidated PE)
Budget Activity: 4 - Tactical Programs

| | | Milestones | | Dates |
|---|---|---|---|---|
| (7) | (U) | ALR-56C RWR Ground Test | | Apr 1984 |
| (8) | (U) | ALQ-135 ICS P3I Development Contract Award | | Mar 1985 |
| (9) | (U) | ALR-56C DT&E/IOT&E Flight Test (concurrent) | | Oct 1985 |
| (10) | (U) | ALQ-135 ICS QRC Band 3 Deliveries | | Feb 1986 |
| (11) | (U) | ALR-56C Deliveries | | May 1986 |
| (12) | (U) | ALQ-135 ICS QRC Band 3 DT&E/IOT&E Flight Test | | May 1986 |
| (13) | (U) | ALE-45 CMD Production Deliveries | | Jul 1986 |
| (14) | (U) | ALQ-135 ICS P3I Critical Design Review | | Nov 1986 |
| (15) | (U) | Integrated F-15 Tactical Electronic Warfare System (TEWS) Flight Test | *(Jun 1987) | Jul 1987 |
| (16) | (U) | ALQ-135 P3I Production Contract Award | *(Aug 1987) | Dec 1986 |
| (17) | (U) | ALQ-135 P3I Production Deliveries | | Aug 1989 |

* Dates presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes

(15) (U) Delay due to range priority
(16) (U) Actual contract award

13. (U) COOPERATIVE AGREEMENTS: Not Applicable.

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## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604315F
DOD Mission Area: 221 - Counterair

Title: Advanced Short Range Air-to-Air Missile (ASRAAM)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 996 | 4,171 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Advanced Short Range Air-to-Air Missile is planned to be the next generation short range missile to meet the Soviet threat of the 1990s. The requirement for ASRAAM is documented in the validated Trilateral Operational Requirement for Advanced Short Range Air-to-Air Missile for the 1990s (USAF Statement of Operational Need 16-82). Technical capabilities for the foreseeable future show that complementary short and medium range air-to-air missiles provide the greatest potential for fulfilling the need for future air-to-air missile systems. Under the terms of the Family of Advanced Air-to-Air Missile Systems Memorandum of Understanding, the United States is developing the Advanced Medium Range Air-to-Air Missile (AMRAAM) and the European governments (Germany, Norway, and the United Kingdom) are developing ASRAAM. A US ASRAAM procurement decision will be made after a complete review of missile cost, schedule, performance, reliability and maintainability. F-15/16 test aircraft integration, a limited Development Test and Evaluation, and Initial Operational Test and Evaluation will be required in support of a production decision. The Project Definition phase began in February 1985 and will continue through 1988. The Engineering Development phase is scheduled to begin in June 1989, although Europe will be commencing full development of several subsystems in 1988. Production deliveries are expected in the mid-1990s. Definitive European contractor estimates are not yet available for missile system costs.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 0 | 3,001 | 9,576 | Continuing | N/A |

EXPLANATION: (U)

- FY 88 reflects a Congressional reduction of $2 million. This reduction will necessitate a delay in the start of most of the funded contractor integration effort.

- The difference in FY 1989 is due to a restructuring of the Air Force ASRAAM program to reflect program delays in the European program.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

PE: 0604315F

5. (U) RELATED ACTIVITIES: ASRAAM is related to the AIM-9L/M Sidewinder (PE 0207161F). The Sidewinder will continue to be a vital element of our short range air-to-air capability in the 1990s and will continue in the inventory through the year 2000. ASRAAM is planned to be the follow-on missile to the AIM-9 in the mid-1990s. Procurement funding for ASRAAM production is being placed in PE 0207161F. The Advanced Medium Range Air-to-Air Missile (AMRAAM) (PE 0604314F) is also related to ASRAAM. AMRAAM is the US contribution to the Family of Advanced Air-to-Air Missile Systems under the terms of the Memorandum of Understanding (MOU).

6. (U) WORK PERFORMED BY: ASRAAM prime contractor is Bodenseewerk Geraetetechnik British Aerospace GmbH (BBG), a joint GE/UK consortium with headquarters in Ueberlingen, GE. Principal subcontractors include British Aerospace Dynamics Group, Hatfield, UK (missile electronics, structure, integration, aerodynamics, aerostructures and thermodynamics); Bodenseewerk Geraetetechnik, GE (seeker, sensor); Raufoss, Norway (rocket motor); Garrett Manufacturing Ltd, Canada (aerodynamic flight control, activation); Messerschmitt-Boelkow-Blohm, GE (warhead); Junghaus, GE (safe and arm unit and contact fuze); and Thorn EMI Electronics, UK (proximity fuze).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604315F, Advanced Short Range Air-to-Air Missile

A. (U) Project Description: ASRAAM is needed to outshoot threat aircraft equipped with weapons equivalent to AIM-9L/M Sidewinder. As an eventual replacement for the Sidewinder, ASRAAM is optimized for close in combat where all aspect, high velocity, high maneuverability, off-boresight capability, and seeker acquisition and tracking are critical performance requirements. The USAF will continue aircraft integration studies, analysis, and data exchanges to ensure ASRAAM is being designed to be compatible with U.S. aircraft.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable.

(2) (U) FY 1988 Program: The FY 1988 planned program funds the establishment of a U.S. program office to be the U.S. focal point for technical interface with the European ASRAAM Joint Project Office (AJPO). U.S. representation in the AJPO has been deferred until FY 1989 due to European program slips. FY 1988 activities include initiation of an Interface Control Working Group (ICWG) between the European prime contractor and U.S. aircraft manufacturers and an International Managment Team (IMT) made of government personnel. These forums will be the vehicle to exchange aircraft integraton data and to control the aircraft interface such that the U.S. can ensure that ASRAAM is being designed to be compatible with the designated U.S. aircraft. Other activities include ASRAAM seeker evaluations and performance assessments.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 planned program establishes U.S. representation in the AJPO in Koblenz, Germany, to ensure continuous liaison in the missile development effort. The MOU contains specific provisions for such representation. Program office representatives will assess ASRAAM technical and performance data and will be consulted by the European program manager on proposed changes to missile specifications and assess resulting effects on U.S. launch aircraft. ICWG support will continue and wind tunnel models and captive test vehicles will be procured to continue aircraft compatiblity efforts. A six degree of freedom simulation will be developed to assist in U.S. performance evaluation.

(4) (U) Program to Completion: This is a continuing program. Aircraft integration efforts will continue and Class 2 modifications to the USAF aircraft will be performed. Hardware for a limited U.S. DT&E program and full IOT&E program will be procured and the tests will be conducted. The procurement decision for ASRAAM will be made after an evaluation of cost, schedule, and performance.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Complete Project Definition Phase | | April 1989 |
| (2) (U) Engineering Development Phase | *(January 1989) | June 1989 |
| (3) (U) Production Deliveries | | Mid-1990s |

*Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Changes

(2) (U) Start of Engineering Development phase slipped by European ASRAAM Joint Project Office due to extensive review of the missile launch concept, rocket motor redesign due to weight growth and the inclusion in PD of the first dispersion test firing as a part of risk reduction.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The Family of Advanced Air-to-Air Missile Systems Memorandum of Understanding (MOU) was signed by the Republic of France, the Federal Republic of Germany, the United Kingdom and the United States in August 1980. (France chose not to participate in the ASRAAM development program and is pursuing an alternative missile system.) Under the MOU, Europe will develop the ASRAAM system and the U.S. will develop the Advanced Medium Range Air-to-Air Missile (AMRAAM). The intent of this cooperative family of weapons program is to conserve resources by avoiding duplication of development costs, provide options for dual-production, and increase NATO standardization and interoperability. The Kingdom of Norway joined Germany and the United Kingdom for ASRAAM development in December,

1984. Other NATO countries are considering whether or not to join the ASRAAM program. A list of major European ASRAAM contractors is found in paragraph 6. Total European ASRAAM program funding cannot be definitively stated. The costs of the Prefeasibility/Feasibility phases (1979-1983) have been estimated at Deutsche Mark (DM) 18 million. The current Project Definition (PD) phase (1983-1987) is estimated to cost DM 275 million, the PD Amendment phase (1988-Apr 1989) is estimated to cost DM 230 million, while the Engineering Development costs are estimated at DM 900 million.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604321F — Title: Joint Tactical Fusion Program (JTFP)
DOD Mission Area: 322- TIARA for Tactical Land Warfare — Budget Activity: 4 - Tactical Program

1. ( RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 24,636 | [ | ] | Continuing | N/A |

Air Force funding is based on a 12.8% share of RDT&E cost.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: JTFP is a joint Army/Air Force effort to develop a near-real-time (NRT) all-source tactical intelligence fusion and processing/dissemination system. The main program consists of the Air Force Enemy Situation Correlation Element (ENSCE) and the Army All Source Analysis System (ASAS). Other JTFP efforts supporting the Air Force include the Intelligence Correlation Element (ICE) software capability, which would provide a fusion/display capability for IBM based intelligence host computers at United States Air Forces, Europe and Pacific Air Forces; and an interim Limited ENSCE (LENSCE) based on existing BETA (LOCE (Limited Operational Capability Europe)) derived capabilities. The needs expressed in Tactical Air Force (TAF) Statement of Need (SON) 319-82 (validated) will not be fulfilled by the ENSCE. The needs expressed in Strategic Air Command (SAC) SON 20-81 (validated) may be satisfied with selected ENSCE software. [ ] Additionally, software for TAF Headquarters host intelligence computers will be procured.

3. COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 24,422 | [ | ] | Continuing | N/A |

EXPLANATION: (U) The $9.029 million reduction in FY 1989 RDT&E will limit the program to support of LOCE/LENSCE only. ENSCE support will be terminated.

4. OTHER APPROPRIATION FUNDS: [ ]

5. (U) RELATED ACTIVITIES: The Army is the Executive Agent for this Joint Program. The program is conducted in accordance with the following documents: US Army, Letter of Instruction (LOI) for JTFP Special Task Force (STF), dated 5 July 1984; Chiefs of Staff Army and Air Force Memorandum for Chairman Joint Chiefs of Staff, Subject: Airland Battle Programs, dated 30 June 1983; and Air Force Program Management Directive 9087(7)/0604321F/0207431F, dated 21 July 1987. Relationships between the Air Staff; Air Force Systems Command (AFSC), the Implementing Command; Tactical Air Command, the Operating Command; and the Joint Program Management Office are continuous. Related Program Elements include: 0603260F, Intelligence Advanced Development; 0207431F, Tactical Air Intelligence Systems; and 0604321A, Joint Tactical Fusion Program (JTFP).

Program Element: 0604321F Title: Joint Tactical Fusion Program (JTFP)
DOD Mission Area: 322 - TIARA for Tactical Land Warfare Budget Activity: 4 - Tactical Programs

6. (U) WORK PERFORMED BY: The Jet Propulsion Laboratory (JPL), California Institute of Technology, Pasadena, California is the systems integration contractor for the ASAS/ENSCE. JPL subcontractors include: TRW, McLean VA; McDonnell Douglas, Huntington Beach, CA; Ford Aerospace Corp, Palo Alto CA; Martin Marietta, Denver, CO; Analytics, McLean VA; and MITRE Corp, Bedford, MA. The prime contractor for the ICE effort is also JPL with the following subcontractors: McDonnell Douglas, Huntington Beach, CA; Digital Fantasies Limited (DFL), Huntington Beach, CA; and Sterling Federal Systems Inc., Bellview, NE. DFL serves as the prime contractor for the LOCE/LENSCE effort. AFSC/Electronic Systems Division is the Air Force in-house developing organization responsible for the Air Force segment of the JTFP.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604321F, Joint Tactical Fusion Program (JTFP):

A. (U) Project Description: Develop the Air Force Enemy Situation Correlation Element (ENSCE) to rapidly receive, correlate, store, display and disseminate enemy target data from a large number of near-real-time (NRT), multi-discipline sensors , provide an interim correlation capability for theater host computers (ICE) and an interim transportable limited ENSCE for TAC until replaced by ENSCE.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 funds provided for continued development of the Intelligence Data Processor and Communications Processor Interface modules as well as a Preliminary Design Review (PDR) and Critical Design Review (CDR) for them. Delivery, testing, and evaluation of the Portable ASAS/ENSCE Work Station (PAWS) and ASAS/ENSCE Interface Module (AIM) occurred and only one USAFE/PACAF software release was delivered. Coding, checkout and test of the ASAS/ENSCE initial software delivery continued. A PDR of the ASAS/ENSCE second and third software release was conducted and detailed design, leading to a CDR for a follow-on release of USAFE/PACAF All Source Processing software was also performed.

(2) (U) FY 1988 Program: All ENSCE and ICE related development activity which cannot be completed using FY88 funds will be deferred indefinitely. The planned integration, testing, and delivery of ICE software will be completed. Design and development will continue for LOCE/LENSCE Version 2.0 software. Delivery of the Stand-alone Communications Sub-System (SACSS) will also be completed as will the delivery of the LENSCE to the 12th Tactical Intelligence Squadron (TIS) completing delivery of hardware to TAC.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will continue limited support to the LOCE/LENSCE project. Cost estimates are Category II, Mature, based on firm contractor prices and engineering estimates made in June 1986.

(4) Program to Completion: [ ]


(548)

C. (U) Major Milestones:

| Milestones | | | | Dates |
|---|---|---|---|---|
| (1) | (U) | Joint Program Charter signed by the Sec Air Force and Army | | February 1982 |
| (2) | (U) | SAC SON 20-81 (Validated) | | October 1982 |
| (3) | (U) | Limited Operational Capability Europe | | December 1982 |
| (4) | (U) | Congressional Direction and Approval | | February 1983 |
| (5) | (U) | TAF SON 319-82 (Validated) | | May 1984 |
| (6) | (U) | Preliminary Design Review | | November 1985 |
| (7) | (U) | Limited ENSCE, 9th Tactical Intelligence Squadron | | January 1986 |
| (8) | (U) | Limited ENSCE, 9th TIS, Hardware Upgrade | (added) | October 1987 |
| (9) | (U) | Limited ENSCE, 12th TIS, Hardware delivered | (added) | January 1988 |
| (10) | (U) | ICE Software Integration Readiness Review | (added) | April 1988 |
| (11) | (U) | LENSCE Stand-alone Communications Sub-System | (added) | June 1988 |
| (12) | (U) | LOCE/LENSCE Software Version 2.0 | (added) | August 1988 |
| (13) | (U) | ICE Software to USAFE/PACAF | (added) | August 1988 |
| (14) | (U) | Preliminary Design of LOCE/LENSCE Software Version 3.0 | (added) | October 1988 |

(U) Explanation of Milestone Changes:

(U) ENSCE Milestones have been deleted.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: There are no specific cooperative agreements regarding the JTFP, no signed documents exist and no foreign funds are provided to the program office. However, the JTFP is an integral part of the Battlefield Information Collection and Exploitation System (BICES). The JTFP is currently supporting BICES Concept and Design Studies (CADS) with the Limited Operational Capability Europe (LOCE) system. The LOCE system is a limited capability Enemy Situation Correlation Element (ENSCE). LOCE terminals are currently on loan to the 1st British Corps and the 1st German Corps in support of BICES CADS. In addition, the Canadians have displayed an interest in using LOCE terminals. Since LOCE is the only intelligence fusion system in the European theater, it is serving as a theater tool to define fusion requirements.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604327F
DOD Mission Area: 223 - Close Air Support and Interdiction
Title: Hardened Target Munitions
Budget Activity: 4 - Tactical Programs

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

| Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 1,494 | 6,279 | 11,300 | 19,073 |
| 3273 | I-2000 $P^3I$ * | 0 | 1,494 | 6,279 | 11,300 | 19,073 |

* Previous I-2000 $P^3I$ efforts were accomplished within PE 0604602F.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Recent Soviet efforts have resulted in a hardened target set that is growing in number. This critical set includes command and control bunkers, hardened aircraft shelters, and underground weapons and fuel storage facilities. Current MK-84 series general purpose bombs suffer from case failure, low order detonation, and ricochet when used against this vital target spectrum. The HAVE VOID/I-2000 warhead (an improved 2000-lb warhead deployed in FY 1986) demonstrated required penetration and destructive performance against this critical target set. Integration of the I-2000 with the GBU-15 guidance system in FY 1989 will provide valuable standoff range for attacking hardened targets.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total |
|---|---|---|---|---|---|
| RDT&E | 0 | 7,690 | 14,085 | 89,320 | 111,095 |

EXPLANATION: (U) The RDT&E FY 1988 funding was reduced by Congress (-$6.19 million). The FY 1989 decrease reflects revised program schedule and removal of AGM-130/I-2000 integration. The change in the total estimated cost for this program reflects a change in program content. Development of a smaller penetrating warhead (I-1000) and integration of the I-2000 with the AGM-130 are no longer required. The Boosted Penetrator program slips to an FY 1993 start.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Hardened Target Munitions program incorporates technologies from Program Elements (PE) 0602602F, 0603601F, 0604602F, and 0604604F in the areas of propulsion, casing, fuzing, and explosives for the boosted penetrator program. The GBU-15 guidance system was developed under PE 0604733F. Applicable procurement PE is 0208030F, Munitions and Associated Equipment.

6. (U) WORK PERFORMED BY: In-house government efforts will be conducted in FY 1988 to include wind tunnel testing at the Air Force's Arnold Engineering Development Center, Tullahoma, TN. Rockwell International, Duluth, GA will refurbish an existing government owned wind tunnel model for the tests. Contractors for the integration effort will be selected in FY 1989. Armament Division at Eglin AFB, FL, is the developing organization responsible for the program.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3273, I-2000 Pre-Planned Product Improvement ($P^3I$)

A. (U) Project Description: This project expands the configurations using the I-2000 warhead (BLU-109/B) by integrating the I-2000 with the GBU-15 guidance system. Integration of the I-2000 with the GBU-15 guidance system will provide a valuable standoff munition for attacking hardened targets.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable.

(2) (U) FY 1988 Program: In FY 1988, wind tunnel testing will be conducted to evaluate the Short Chord wing configuration of the GBU-15/I-2000. Preparations will be made for award of the integration contracts early in FY 1989.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In 1st Quarter FY 1989, a full scale development contract for the integration effort will be awarded. Initial development will include incorporating the capability to attack hardened targets with the GBU-15/I-2000 by ensuring weapon aerodynamic stability and by modifying weapon software. In addition, the AN/GTM-55 Test Set will be modified to include GBU-15/I-2000 test capability.

(4) (U) Program to Completion: In FY 1990, the Critical Design Review will be conducted. Hardware will be procured for flight testing. Development Test and Evaluation/Initial Operational Test and Evaluation will be conducted in FY 1990 and 1991 to support a low rate production decision in FY 1991. Up to 2600 weapon autopilots will be modified and 1200 conversion kits procured in the production/modification program with Other Procurement Appropriation funding beginning in FY 1991.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Contract Award | *(June 1988) | December 1988 |
| (2) | (U) | Critical Design Review | *(1st Quarter FY 1988) | 2nd Quarter FY 1990 |
| (3) | (U) | Development Test and Evaluation/ Initial Operational Test and Evaluation | *(February 1989-September 1989) | October 1990 - October 1991 |

* Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes:

(U) Changes in schedule milestones (1) through (3) were caused by Congressional action which reduced funds for FY 1988 and a resulting revision of the program schedule.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604601F
DOD Mission Area: 276 - Defensive Chemical and Biological Systems

Title: Chemical/Biological Defense Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 21,653 | 14,543 | 17,661 | Continuing | N/A |
| 3321 | Chemical and Biological Agent Detection & Warning | 2,100 | 113 | 4,531 | Continuing | N/A |
| 3337 | Individual Protection | 10,353 | 10,138 | 12,357 | Continuing | N/A |
| 3762 | Collective Protection | 6,500 | 3,504 | 552 | Continuing | N/A |
| 3764 | Decontamination | 1,700 | 788 | 221 | Continuing | N/A |
| 5171 | Bigeye | 1,000 | 0 | 0 | 0 | 8,140 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops systems to detect, warn against, protect, and decontaminate personnel and equipment from chemical/biological agents. These systems will allow the Air Force to continue its mission in a chemical/biological environment and provide a critical deterrent to Soviet use of chemical/biological weapons. Without these protective systems, sortie generation on a sustained basis will be degraded significantly. This program also funded the Air Force munitions development of the Bigeye binary chemical bomb, which has transitioned to production. BIGEYE production is funded in PE 0208030F, War Reserve Materiel Ammunition.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 22,198 | 14,600 | 17,678 | Continuing | N/A |
| Other Procurement | 81,494 | 108,960 | 198,539 | Continuing | N/A |

EXPLANATION: (U) Procurement funding changes reflect congressional budget constraints. The schedule for fielding Survivable Collective Protection Systems will be extended. Full rate production and installation of Aircrew Eye-Respiratory Protection systems will be restricted to a limited number of fighter aircraft types through FY 1994.

PE: 0604601F

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement Funds | 79,948 | 105,444 | 95,766 | Continuing | N/A |
| Operation and Maintenance Funds | 29,739 | 22,738 | 23,000 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: The related Air Force programs are: PE 0207593F, Chemical Biological Defense Program, PE 0602202F, Aerospace Biotechnology; PE 0603231F, Crew Systems Technology; PE 0604617F, Air Base Operability; and PE 0604703F Aeromedical Chemical Defense Systems Development. Tasks are coordinated with other services in accordance with the Joint Service Agreement on Chemical Warfare and Chemical-Biological Defense Requirements, Research, Development, and Acquisition of 5 July 1984. The related Army programs are: PE 0603806A, Chemical/Biological Defense Equipment Advanced Development; PE 0604806A, Chemical/Biological Defense Equipment Engineering Development. The related Navy programs are: PE 0602233N, Mission Support Technology; PE 0603514N, Ship Survivability; and PE 0604506N, Biological Radiological/Chemical Warfare Countermeasures. The related Marine Corps program is PE 0603635M, Marine Corps Ground Combat/Support Arms.

6. (U) WORK PERFORMED BY: The top five contractors are: (1) Boeing Advanced Systems Company, Seattle WA (Project 3337, Individual Protection); (2) Mine Safety Appliances, Pittsburg PA (Project 3337, Individual Protection); (3) BMY Corporation, York PA (Project 3762, Collective Protection); (4) ILC Dover, Frederica DE (Project 3762, Collective Protection); and (5) Scott Aviation, Sierra Madre CA (3337, Individual Protection). There are four additional contractors, and the total value of the additional contracts is $1.0 million. The in-house developing organization for projects 3321, 3337, 3762, and 3764 is Air Force Systems Command's Aeronautical Systems Division, Life Support Systems Program Office, Wright-Patterson AFB OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3762, Collective Protection. The purpose of this project is to develop collective protection systems for use in a chemical warfare environment to provide for rest and relief of groups of personnel and allow performance of selected tasks which cannot be performed by personnel encumbered by individual protective equipment. The first Survivable Collective Protection System (SCPS) initial production units were fielded in FY 1986. In FY 1987, SCPS pre-planned product improvements continued on schedule. Development continued on a family of Transportable Collective Protection Shelters. Operational Demonstrations were conducted on Transportable Collective Protection

Shelters in FY 1987. The demonstrations evaluated the addition of a contamination control area to existing modular collective protection equipment, simplified collective protection equipment, and several current inventory mobile shelters. In addition, development will begin on chemical hardening of other selected shelters and facilities. These tasks will continue in FY 1989 and beyond. In FY 1990 a production decision will be made for an improved version of the Army's M-20 Simplified Collective Protection Equipment.

B. (U) Project: 3764, Decontamination. This project develops materials, methods, and equipment for removing/neutralizing chemical warfare agents from personnel, vehicles, aircraft, equipment and facilities without imposing adverse effects on equipment and mission performance. Decontamination is required so personnel can work safely and unencumbered after a chemical/biological attack. The FY 1987 program provided for installation engineering of a large version of an avionics decontamination system and development of a smaller system which will continue in FY 1988. The FY 1989 program will initiate development of an aircraft interior decontamination system and continue development of the avionics decontamination system. A production decision for the avionics decontamination system (small chamber) will be made in early FY 1990. Tasks beyond FY 1990 will focus on techniques and equipment for decontamination of air base critical equipment and components.

C. (U) Project: 3321, Chemical and Biological Agent Detection and Warning. This project develops a capability to detect and warn against chemical and biological agents automatically and indicate the degree and location of contamination so that corrective action can be taken to allow unimpeded continuation of the mission. The Air Force will continue to monitor the Army's development of ion mobility spectroscopy technology under the Advanced Chemical Agent Detector and Alarm (currently a 6.3 program). The Automatic Liquid Agent Detector will go into production in FY 1988. The FY 1989 program also will start full-scale development of a Fixed Site Chemical Detection and Warning System (FSDWS). Tasks beyond FY 1990 will continue development of the FSDWS.

8. (U) SINGLE PROJECT OVER $ 10 MIILLION IN FY 1989:

(U) Project: 3337, Individual Protection

A. (U) Project Description: This project develops protective ensembles and equipment systems. These systems will protect personnel from effects of chemical or biological agents and allow them to maintain mission performance effectiveness. Work under this project includes development of the Aircrew Eye-Respiratory Protection system, aircrew chemical protective ensemble, an Impermeable Protective (IMP) Suit for Air Force special teams, and body cooling systems. The IMP suit will be used by Explosive Ordnance Disposal personnel and is based on technology demonstrated during an air base survivability exercise in Europe during the spring of 1985. The Aircrew Eye-Respiratory Protection System (AERP) is the improved aircrew mask program. The AERP program approach is to adapt components of successful mask developments to applicable aircraft and begin fielding mask systems by FY 1990. Masks being considered under the AERP program include the Tactical Aircrew Eye Respiratory System (ILC Dover Corp.) and the Protective Integrated Hood Mask (ILC Dover Corp).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 program initiated Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) of an AERP system for the F-16, C-130, and the KC-135, and initiated development of the aircraft integration hardware for these aircraft. In addition, it continued development of the new aircrew chemical defense ensemble and the IMP suit.

(2) (U) FY 1988 Program: The FY 1988 program continues DT&E/IOT&E of AERP systems. A production decision will also be made on the aircrew chemical defense ensemble in FY 1988.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will continue IOT&E of AERP systems for additional aircraft types, with a limited production decision for the top three categories of aircraft. Development will continue on the IMP suit. Cost estimates are Category III, based on competitive procurement for full scale development and firm contractor prices.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| | Milestones | Dates |
|---|---|---|
| (1) (U) | Aircrew Ensemble Production Decision | September 1988 |
| (2) (U) | AERP, First Article Delivered | July 1989 |
| (3) (U) | IMP Suit, Complete DT&E | February 1990 |
| (4) (U) | IMP Suit, Production Decision | October 1990 |
| (5) (U) | AERP, Initial Operational Capability (IOC) | November 1990 |
| (6) (U) | Aircrew Ensemble, IOC | 1st Quarter FY 1991 |
| (7) (U) | IMP Suit, IOC | January 1992 |

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604602F — Title: Armament/Ordnance Development
DOD Mission Area: 223 - Close Air Support and Interdiction — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 19,582 | 13,800 | 19,158 | Continuing | N/A |
| 2586 | Direct Airfield Attack Combined Munition | 9,751 | 8,449 | 13,460 | 44,963 | 76,623 |
| 2784 | Armament Standardization/Control | 2,048 | 1,011 | 985 | Continuing | N/A |
| 3113 | HAVE VOID/I-2000 Warhead | 1,148 | 1,785 | 0 | 0 | 27,835 |
| 3133 | Bombs and Fuzes | 2,581 | 1,725 | 2,551 | Continuing | N/A |
| 3627 | Cast Bomb Development | 4,034 | 0 | 983 | 0 | 5,017 |
| 5613 | Munitions Material Handling Equipment/ Containers | 20 | 830 | 1,179 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This PE is the primary source for modernizing and developing unguided air-to-surface conventional munitions and associated equipment. The program supports numerous Strategic Air Command and Tactical Air Forces Statements of Need. There are two categories of efforts: those to provide new capabilities to fill operational voids, and those to eliminate deficiencies in current capabilities by modernizing existing munitions and equipment. Efforts also include formal organizations to help standardize munitions and associated equipment among the services. Activities involve the engineering design, development, test and evaluation of a variety of improved conventional weapons and munitions handling equipment. This PE includes: bombs and hardened target warheads; unguided dispenser munitions; bomb fuzes and proximity sensors; munitions handling equipment and containers.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 20,000 | 25,629 | 19,176 | Continuing | N/A |
| Aircraft Procurement (PE 0208031F) | 0 | 2,814 | 0 | 3,279 | 9,893 |
| Missile Procurement (PE 0101122F) | 3,961 | 0 | 0 | 0 | 7,682 |
| Other Procurement (PE 0208030F) | 70,855 | 76,522 | 76,338 | Continuing | N/A |
| (PE 0208031F) | 0 | 9,807 | 14,783 | 25,735 | 50,325 |

Program Element: 0604602F  Title: Armament/Ordnance Development
DOD Mission Area: 223 - Close Air Support and Interdiction  Budget Activity: 4 - Tactical Programs

**EXPLANATION:** **(U)** The **RDT&E FY 1987 funding** was reduced (-$0.42 million) for Small Business Innovative Research and a higher priority reprogramming. The RDT&E FY 1988 funding was reduced by Congress (-$11.5 million) resulting in cancellation of the Munitions Storage Enhancement project and reduction of Project 2586. In addition, RDT&E FY 1988 funding (-$0.33 million) was reprogrammed to other high priority Air Force requirements. The Aircraft Procurement Appropriation funding for Project 5613 was moved from FY 1988 (-$2.8 million) to FY 1989 (+$2.6 million). The Other Procurement Appropriation changes follow. The FY 1987 change (-$12.8 million) is due to deletion of funding in the FY 1987 Supplemental Request (-$20.0 million) and reprogramming action ($+7.2 million). for Project 3113. The FY 1988 change (-$15.3 million) is a result of Congressional reductions for Project 3590 (mechanical diverters, -$9.8 million) and Project 3133 (FMU-139 fuze, -$5.5 million). The FY 1989 reduction (-$25.8 million) is due to Project 3133 (FMU-139 fuze repricing, -$11.0 million) and Project 3590 (cancellation of mechanical diverters, -$14.8 million). The FY 1989 Missile Procurement Appropriation is increased (+$2.3 million) in Project 5613 due to increased requirements for the One Step Loading Adapter.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Project #5613, Manually Operated Lift Truck | | | | | |
| Funds (PE 0208031F) | 0 | 0 | 2,550 | 3,279 | 9,476 |
| Quantities | 0 | 0 | 302 | 343 | |
| Missile Procurement: | | | | | |
| Project #5613, One Step Loading Adapter | | | | | |
| Funds (PE 0101122F) | 4,000 | 0 | 2,323 | 0 | 10,444 |
| Quantities | 560 | 0 | 350 | 0 | |
| Other Procurement: | | | | | |
| Project #3113, I-2000 Warhead | | | | | |
| Funds (PE 0208030F) | 24,535 | 32,567 | 31,877 | Continuing | N/A |
| Quantities | 2,140 | 2,480 | 2,610 | | |
| Project #3133, FMU-139 Fuze* | | | | | |
| Funds (PE 0208030F) | 30,379 | 34,467 | 30,127 | Continuing | N/A |
| Quantities (FMU-139/B) | 36,071 | 26,789 | 27,698 | | |
| (DSU-30/B) | 0 | 0 | 5,000 | | |

* This line includes both the FMU-139/B fuze and the DSU-30/B proximity sensor.

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Project #3133, Timer, Actuator, Fin and Fuze | | | | | |
| Funds (PE 0208030F) | 3,166 | 3,988 | 3,334 | Continuing | N/A |
| Quantities | 1,500 | 12,159 | 11,245 | .. | |

5. (U) **RELATED ACTIVITIES:** Submunitions such as the BLU-106/B, Bomb, Kinetic Energy Penetrator, developed in PE 0604604F, Submunitions Development, are selected for integration into unguided dispensers under this PE. Items from the advanced development program, PE 0603601F, Conventional Weapons, such as the Standard Avionics Integrated Fuze are selected for continuation into Full Scale Development under this PE. The FMU-139 fuze and DSU-30 Proximity Sensor, under Project 3133, are joint US Navy and US Air Force programs. Close liaison is maintained between the services through the Joint Technical Coordinating Group for Munitions Development and through coordination with the Department of Defense Armaments/Munitions Requirements and Development Committee.

6. (U) **WORK PERFORMED BY:** This PE is managed by the Armament Division at Eglin AFB, FL. The major contractors are Textron Defense Systems, Wilmington, MA, (Project 2586); Lockheed Missiles and Space Company, Sunnyvale, CA, (Project 3113); Motorola Corporation, Scottsdale, AZ, (Project 3133); AAI, Baltimore, MD (Project 3133). There are six additional contractors with contracts totalling $2.0 million.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:**

A. (U) Project: 2784, Armament Standardization/Control. This project supports continuing activities which increase standardization and commonality in armament subsystems. The goal is to reduce proliferation and take maximum advantage of prior investments. In FY 1987 efforts began to define and establish a comprehensive aircraft/munitions data base which will provide ready access to aircraft to armament system interface technical data. Development of standard modular software programs applicable to more than one munition began and will apply the Ada programming language. Development of Military Standard 1760 and definition of procedures/ policies necessary for implementation are continuing efforts under this project. The aircraft/munitions technical interface data base effort will be in the data identification/collection phase. In FY 1988 investigations into feasibility of fuze and armament test set standardization will begin, the objective being to avoid proliferation of similar material and to reduce development cost and time. This standardization effort continues in FY 1989.

B. (U) Project: 3133, Bombs and Fuzes. This project develops and improves bombs and fuzes. In FY 1987 Development Test and Evaluation (DT&E) of the Timer, Actuator, Fin and Fuze (TAFF) was successfully completed. The TAFF is a timing device which delays the fin/retarder actuator on high-drag general purpose bombs until the munition is clear

of the bomb bay of B-1B aircraft. In FY 1988 TAFF Initial Operational Test and Evaluation (IOT&E) will be completed and initial production begins. Full rate production of the TAFF is planned to begin in December 1988. In FY 1987 testing of the DSU-33 and the Navy DSU-30 proximity sensor was conducted and the DSU-30 was selected as the joint service proximity sensor. Development of the DSU-33 was stopped. In FY 1988 Air Force DT&E of the DSU-30 will be completed and IOT&E testing will begin. In FY 1989 IOT&E testing of the DSU-30 will be completed and production will begin. In FY 1989 studies to prepare for Full Scale Development (FSD) of the Standard Avionics Integrated Fuze (SAIF) will begin. The SAIF is a fuze for air-to-surface weapons which will allow the fuze to be set from the aircraft avionics data bus, thereby matching the fuze setting with the actual delivery conditions for maximum effectiveness. These studies will consider feasibility of designing the SAIF to be installed in the bomb thereby resulting in an All-Up-Round status without altering the hazard classification of the weapon and also to determine its utility as a hardened target fuze. In FY 1990 FSD of the SAIF begins.

C. (U) Project: 3627, Cast Bomb Development. This project is a Congressionally directed effort to fully qualify a cast version of the I-2000 bomb body using $4.0 million of the appropriated FY 1987 funds. The results of this work are to be reported to the Committees on Appropriations when completed. Efforts began in late FY 1987 and will be completed in FY 1989.

D. (U) Project: 5613, Munitions Material Handling Equipment/Containers. This project develops more capable bomb racks, ejectors and associated handling/release equipment, and improves munitions material handling equipment and development of containers. There are no active munitions carriage and release equipment efforts. The Munitions Material Handling Equipment (MMHE) data retrieval system is maintained to ensure maximum use of existing munitions handling equipment and other related items. The Container Design Retrieval System (CDRS) is maintained to ensure maximum use of existing containers throughout all services. The CDRS is a continuing effort which has produced documented savings of $47 million from October 1979 to October 1987. To facilitate management of this task the CDRS and Munitions Material Handling Equipment efforts (and funding) are transferred from Project 2784 to Project 5613 beginning in FY 1988. In FY 1988 and 1989 the MMHE data bases will be maintained to continue support to on-going munitions programs. In February 1987 the Simplified Munitions Lift Trailer was terminated for default. In FY 1988 IOT&E of a Manually Operated Lift Truck to augment the powered loader force will be completed and a production decision made. In FY 1990 preparations for FSD for an All-Terrain- Ammunition-Trailer (ATAT) will be initiated. The ATAT will be capable of dispersing munitions in bare base environments where minimal roads exist and/or where roads have been damaged by enemy attack. In FY 1991 the ATAT FSD will begin and planning will begin to apply the emerging technology of robotics and muscle multipliers to the task of handling and loading munitions.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2586, Direct Airfield Attack Combined Munition

A. (U) Project Description: The Direct Airfield Attack Munition program will integrate eight BLU-106/Bs, Bomb, Kinetic Energy Penetrator, and 24 British HB876LE area denial mines into a tactical munitions dispenser.

Program Element: 0604602F    Title: Armament/Ordnance Development
DOD Mission Area: 223 - Close Air Support and Interdiction    Budget Activity: 4 - Tactical Programs

The Direct Airfield Attack combined Munition (DAACM) will significantly improve our airfield attack capability with multiple cratering of runway and taxiway surfaces. The mines are dispensed with the Bomb, Kinetic Energy Penetrators (BKEPs) to impede repair operations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Critical Design Review (CDR) for the BKEP was conducted. Final qualification testing of the preferred fuze for the BKEP began. The Request for Proposal (RFP) for DAACM was released in July 1987. A dual contractor Full Scale Development (FSD) effort is planned to reduce technical/schedule risk and to provide benefits of a competitive development effort. Three RFP amendments were released to incorporate further programmatic requirements in light of BKEP program technical difficulties.

(2) (U) FY 1988 Program: DAACM proposals are due in January 1988 and contract award is planned for June 1988. The contractors will conduct Preliminary Design Reviews (PDR). Based on approval of the PDR the contractors will fabricate DAACM units for prototype testing.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Upon completion of prototype testing, each contractor will present a baseline design to the government for approval at Critical Design Reviews. Fabrication and assembly of DAACMs for Development Test and Evaluation (DT&E) will occur.

(4) (U) Program to Completion: Upon successful completion of DT&E flight testing, a single contractor will be selected to continue the FSD program. During FY 1990 and 1991, fabrication of Initial Operational Test and Evaluation (IOT&E) hardware will occur. In FY 1992, DAACM FSD ends following completion of IOT&E flight tests. During the last third of IOT&E, a decision for low rate initial production will be made.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) DAACM FSD Contract Award | *(4th Quarter FY 1987) | June 1988 |
| (2) (U) DAACM PDR | *(January 1988) | September 1988 |
| (3) (U) DAACM CDR | *(November 1988) | July 1989 |
| (4) (U) DAACM DT&E Complete | | October 1990 |
| (5) (U) Downselect to single contractor | | 1st Quarter FY 1991 |
| (6) (U) DAACM Low Rate Production Decision | *(FY 1990) | June 1991 |
| (7) (U) IOT&E Complete | *(4th Quarter FY 1990) | October 1991 |

*Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) (U) Direct Airfield Attack Combined Munition (DAACM) full scale development (FSD) contract award delayed due to Bomb, Kinetic Energy Penetrator (BKEP) contractor schedule performance in providing submunitions for flight qualification testing. Results of qualification tests will be used to provide a detailed technical data package to the DAACM FSD contractors. All milestone dates were adjusted due to this delay.

9. (U) **COOPERATIVE AGREEMENTS:** Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET DESCRIPTIVE SUMMARY

Program Element: 0604604F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Submunitions
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 4,712 | 4,650 | 7,326 | Continuing | N/A |
| 3166 | Terminally Guided Submissile (TGSM)/ Sense and Destroy Armor (SADARM)/ Skeet Evaluation and Submunition Development | 4,712 | 4,650 | 7,326 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Project 3089 commonly known as "Chicken Little" has been merged with Project 3166, Terminally Guided Submissile (TGSM)/Sense and Destroy Armor (SADARM)/Skeet Evaluation and Submunition Development, to continue Chicken Little activities. Project 3166 evaluates TGSM, SADARM, and Skeet submunition performance and has been expanded to determine antiarmor submunitions performance against actual foreign targets. This project provides the basis for institutionalizing the Chicken Little approach for evaluating antiarmor submunitions. Armor targets required to conduct development tests to evaluate operational munitions and to provide independent target sets for the Chicken Little approach will be acquired within Project 3166. Project 3166 is a joint project with the US Army and the US Navy.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 4,757 | 4,668 | 7,333 | Continuing | N/A |

EXPLANATION: (U) FY 1988 difference is due to undistributed Congressional reduction. FY 1989 difference is due to OSD personnel factor repricing.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Prior to FY 1985, evaluation of the Terminally Guided Submissile (TGSM) was included in the US Army PE 0603303A, Surface-to-Surface Missile Rocket System. Sense and Destroy Armor Munition (SADARM) development effort is conducted under Army PE 0603628A, Field Artillery Ammunition Development, and PE 0604631A, Field Artillery Ammunition. Development of the Sensor Fuzed Weapon using Skeet warhead is conducted in PE 0604607F.

PE: 0604604F



(563)

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters Air Force Systems Command, Andrews Air Force Base MD, and its subordinate organization, Armament Division, Eglin Air Force Base FL. Contractor support for the TGSM is provided by General Dynamics Corporation, Pomona CA. Contractor support for the SADARM program is provided by Aerojet Corporation, Downey CA and Honeywell Inc, Hopkins MN. Contract support for the Skeet submunition is provided by Textron Defense Systems, Wilmington MA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3166, Terminally Guided Submissile (TGSM)/Sense and Destroy Armor (SADARM)/Skeet Evaluation and Submunition Development

A. (U) Project Description: TGSM and SADARM are US Army development efforts. TGSM was a submunition candidate for the Assault Breaker Program. SADARM is an artillery fired weapon with smart sensors to improve the probability of a hit. The sensor fuzed and shaped charge warhead (Skeet) is a US Air Force development effort which will be employed in the Sensor Fuzed Weapon. These submunitions will be evaluated for potential application by the Air Force for delivery from standoff weapons. This evaluation includes submunition testing and has been expanded to include the evaluation of effectiveness against actual foreign targets. The project consists of studies, analysis, and warhead/sensor testing. SADARM, TGSM, and Skeet testing will continue against newer targets and potential countermeasures. A dedicated target set and high fidelity simulators will be procured to enable expanded testing of candidate submunitions for US or Allied applications.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Warhead and sensor effectiveness testing against additional countermeasures targets continued. Weapons level cost effectiveness analysis was completed in order to accomplish a submunition to submunition evaluation of a "generic" 1000 pound class weapon.

(2) (U) FY 1988 Program: Submunition warhead evaluation and seeker/sensor flight test will continue in FY 1988. Improved submunitions will be tested against newer targets in winter and subtropical environments. Acquisition of armor targets, as they become available, is planned.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Chicken Little testing will continue against newer targets with potential countermeasures. Dedicated targets will be acquired and high fidelity simulators developed. Updating of target characteristics for submunition effectiveness modelling will be accomplished. Improved submunitions will be tested against newer targets in a desert environment.

(4) (U) Program to Completion: Institutionalization of submunition testing to provide an "honest broker" test capability for evaluation of submunitions for future integration into weapons such as the Modular Standoff Weapon. Continued acquisition of armored targets and simulators to form an up-to-date target complex.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The government of Israel (GOI) participated from FY 1985 through FY 1987 in the initial phase of the Chicken Little Project under a Memorandum of Understanding (MOU) with the Government of the United States. The GOI provided equipment for use in Chicken Little and personnel on site at Eglin AFB, FL, to support testing and data analysis. Funds were not exchanged between governments. The GOI will not participate in Phase II of Chicken Little.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604607F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Wide Area Anti-Armor Munitions
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 23,328 | 22,520 | 26,752 | 0 | 153,506 |
| 2961 | Sensor Fuzed Weapon | 23,328 | 22,520 | 26,752 | 0 | 153,506 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Tactical Air Forces require a capability to destroy multiple enemy armored vehicles during a single aircraft pass to overcome the existing large numerical imbalance of Warsaw Pact armor. This need is documented in the Mission Element Need Statement for an Improved Wide Area Antiarmor Capability. The Sensor Fuzed Weapon (SFW) program is an outgrowth of the Wide Area Antiarmor Munition umbrella program. This PE will accomplish full scale development of SFW.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total |
|---|---|---|---|---|---|
| RDT&E | 23,872 | 17,607 | 13,278 | 0 | 135,663 |
| Other Procurement | 0 | 0 | 111,196 | 2,917,014 | 3,028,210 |

EXPLANATION: (U) RDT&E: In FY 1988 Congress appropriated an additional $5 million for the SFW effort. The Air Force plans to use these funds to buy SFW stores for SEEK EAGLE testing. FY 1989 request was increased to procure additional SEEK EAGLE test stores required to demonstrate F-16 compatibility and avoid a 2 year delay in initial operational capability.

(U) Other Procurement: Technical problems encountered during contractor testing resulted in a nine month delay in the Critical Design Review. As a result, the Milestone IIIA review slipped from November 1988 to August 1989. To maintain alignment between funding and procurement schedules the FY 1989 procurement funding was deleted. The technical problems have been resolved and incoporated into the hardware design. The subsequent test program has been highly successful including the first ever weapon-level SFW tests.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

5. (U) RELATED ACTIVITIES: SFW technology support is ongoing in Program Element 0602602F, Conventional Munitions; Program Element 0603601F, Conventional Weapons Technology; and 0604604F, Submunitions Development. Warhead, sensor, seeker, and dispenser technology programs in these program elements provided the basis for the SFW concept. Weapon concept demonstration/validation was accomplished in Program Element 0603609F, Advanced Attack Weapons.

Program Element: 0604607F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Wide Area Anti-Armor Munitions
Budget Activity: 4 - Tactical Programs

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command, Andrews Air Force Base, MD and its subordinate organization, Armament Division, Eglin Air Force Base FL. Contractor support for the SFW is provided by Textron Defense Systems, Wilmington MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2961, Sensor Fuzed Weapon

A. (U) Project Description: SFW is a 1000 pound cluster weapon which consists of a Tactical Munitions Dispenser (TMD) packaged with 40 armor defeating warhead mechanisms. The warhead mechanism, commonly called "Skeet", consists of a self-forging fragment and infrared detector which detects hot areas on the target and initiates the warhead. The smart cluster weapon will provide multiple kills per single aircraft pass thereby increasing operational effectiveness while reducing aircraft/aircrew losses in attacks against armored targets.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Continued Full Scale Development (FSD) with submunition testing and TMD integration leading to three contractor tests of live all-up TMDs in FY 1988, prior to Critical Design Review (CDR).

(2) (U) FY 1988 Program: FSD continues in FY 1988. After the CDR in March 1988, qualification tests and fabrication of test hardware for Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) will begin. The subsystem and system qualification testing will be completed by the contractor. DT&E will begin in FY 1988. DT&E will include 20 submunition (BLU-108/B) tests which verify the ability of the BLU-108/B to deploy the Skeet and the Skeet's performance in acquiring the target and firing the warhead. Also, 28 full Sensor Fuzed Weapon (SFW) tests from F-16 and other tactical and strategic aircraft will be accomplished. In addition, 42 SFW test stores will be procured to conduct ballistic verification tests to quantify SFW's ballistic characteristics.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: DT&E will be completed in the second quarter of the year. IOT&E will begin by the second quarter and include 36 live SFW tests from the candidate aircraft in operational mission scenarios against realistic target sets. FSD will continue throughout the year with the implementation of Pre-Planned Product Improvements to correct problems found during DT&E and IOT&E. SEEK EAGLE testing of SFW on tactical and strategic aircraft, including measurement of SFW ballistic characteristics, will continue. In addition, 36 SFW test stores will be procured to verify the accuracy of software changes in the F-16 operational flight program required to deliver SFW. Tasks to develop a second source will be accomplished. The procurement program beginning in FY 1990 will be conducted in PE 0208030F, War Readiness Material Munitions.

(4) (U) Program to Completion: FY 1989 is the last planned year for RDT&E funding.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) System Demonstration Complete | | December 1983 |
| (2) (U) Risk Reduction Contract Award | | July 1984 |
| (3) (U) Full Scale Development (FSD) Start | | November 1985 |
| (4) (U) Critical Design Review | *(October 1987) | March 1988 |
| (5) (U) Initial Production Decision | *(November 1988) | August 1989 |

*Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes:

(4,5) (U) Critical Design Review and Initial Production Decision slipped due to delays in resolving, retesting, and completing the fixes to technical problems found during contractor testing.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 4. Tactical Programs AS OF: February 1988
Program Element: 0604607F, Wide Area Antiarmor Munitions (WAAM)

**Test and Evaluation Data**

1. (U) Development Test and Evaluation (DT&E):

Full Scale Development: Sensor Fuzed Weapon (SFW) full scale development includes contractor subsystem and system qualification testing and Air Force DT&E/Initial Operational Test and Evaluation (IOT&E). Contractor testing has continued with subsystem level testing leading to all-up-round (AUR) flight test before Critical Design Review (CDR) in March 1988. During subsystem testing, a design deficiency was identified with the submunition structure. The structure has been redesigned to include using a thicker shell and welded-in structural supports. A cast structure is planned for use in post-CDR hardware. The welded structure has successfully passed static and dynamic tests, several subsystem tests, and an AUR flight test. Up to six more flight tests, including five with live skeets against a target array are planned before CDR. The SFW warhead has undergone intensive testing in an Air Force/Army test and evaluation program named Chicken Little, which evaluates the effectiveness of top attack submunitions. The SFW's warhead infrared sensor was found capable of detecting the heat sources in a wide range of armored vehicles and a variety of countermeasures. The probability of detection and false alarm rate were sufficiently balanced to enable SFW to effectively engage Soviet mobile armored forces

The warhead's explosively formed penetrator was found effective

(U) DT&E is combined with the IOT&E. The SFW DT&E/IOT&E testing is scheduled to be conducted during FY 1988 and FY 1989. The primary test objectives for this phase are to: (1) evaluate baseline system performance characteristics against thresholds, (2) verify the predicted number of kills per pass against specified targets, and (3) evaluate the effect of probable countermeasures on system performance. An assessment of the system support concept in meeting logistics requirements will be made. The Air Force Operational Test and Evaluation Center will have the overall management responsibility for the IOT&E program. (Their effort is discussed in paragraph 2 below.) The combined DT&E/IOT&E program will include 64 SFW all-up-round tests. All-up-round tests in IOT&E will be from candidate aircraft in operational mission scenarios against realistic target sets. The majority of the DT&E/IOT&E will be conducted at Eglin Air Force Base FL. However, other test ranges such as those at China Lake CA and Fort Drum NY are likely to be used. Many of the planned production processes will be used to manufacture the test hardware. System reliability, availability, and logistics support will be tested during this phase. Program management is provided by Headquarters Air Force Systems Command, Andrews Air Force Base MD and its subordinate organization, Armament Division, Eglin Air Force Base FL. The Program Manager is Lieutenant Colonel Charles A. Douglass. Contractor SFW development, subsystem tests, and military qualification tests are being conducted by Textron Defense Systems at its facility in Wilmington MA. The majority of DT&E will be conducted by the Air Force Systems Command Armament Division.

Budget Activity: 4. Tactical Programs
Program Element: 0604607F, Wide Area Antiarmor Munitions (WAAM)

2. (U) Operational Test and Evaluation (OT&E): The Wide Area Antiarmor Munitions (WAAM) program was cancelled in March 1985, but the Sensor Fuzed Weapon (SFW) program is funded under PE 0604607F and has inherited several of the WAAM requirements documents, i.e., Generalized Operational Requirements, Mission Element Need Statement, and Decision Coordinating Paper. OT&E is required for SFW, and the Air Force Operational Test and Evaluation Center (AFOTEC) has been assigned overall management responsibility.

(U) AFOTEC has monitored SFW development since program initiation in 1982. All testing to date has been contractor development test and evaluation (DT&E) during demonstration/validation and early full-scale engineering development. Government DT&E is scheduled to begin in mid-1988, Initial Operational Test and Evaluation (IOT&E) in January 1989.

(U) Critical operational issues for SFW IOT&E are: (1) the ability of the SFW to achieve multiple vehicle kills per delivery pass, (2) weapon system reliability, (3) impact on delivery aircraft tactical flexibility/survivability, (4) system effectiveness in the presence of countermeasures, (5) factors influencing availability, and (6) compatibility with delivery aircraft systems. Most government DT&E/IOT&E test events will be conducted separately, but in close coordination. A common system performance database will be used to the greatest extent possible. Thirty-six all-up live SFW rounds are programmed for IOT&E.

(U) Test locations for SFW IOT&E will be Eglin AFB FL, Nellis AFB NV, and a yet-to-be-determined northern tier location. Candidates for the northern tier testing are Fort Drum NY, Grayling MI, and the Utah Training and Test Range UT. The primary test site will be Eglin AFB FL. Missions at the other locations are necessary to evaluate system performance in a desert (Nellis) and simulated Central European winter environment. Instrumentation and targets will be a significant challenge at all test locations, particularly the northern tier range, due to the very large lethal area covered by an SFW round (1/2 million square feet).

(U) Detailed IOT&E planning is underway. Such details, as are available at this time, are published in the SFW Test and Evaluation Master Plan (TEMP). The draft TEMP will be updated as more details are firmed up, and AFOTEC will publish an SFW IOT&E test plan in mid-1988.

(U) There has been no SFW OT&E to date and no reports have been published. The draft SFW TEMP is in coordination.

Budget Activity: 4. Tactical Programs
Program Element: 0604607F, Wide Area Antiarmor Munitions (WAAM)

3. (U) System Characteristics: Characteristics for the Sensor Fuzed Weapon (SFW) will be definitized during the Full Scale Development phase. The primary objectives of the program are to develop a system that can achieve multiple kills per pass against massed armor targets. Specific thresholds for the SFW system are identified in the draft Test and Evaluation Master Plan (TEMP).

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| (U) Target Set | Tanks, Self-Propelled Artillery, Armored Personnel Carriers, and Trucks as found in the Soviet Reinforced Regiment Advanced Guard (RRAG) | TBD |
| (U) Low Level Delivery | 200 ft (60m) | TBD |
| Warhead Capability | Penetration of proof[1] target at to explosively formed penetrator flight path | Target Defeated |
| Footprint size | | TBD |
| Probability of mobility kill given a hit: | | |
| Tanks | | TBD |
| Soft armor | | TBD |
| Trucks | | TBD |
| System effectiveness | mobility kills per pass with 4 weapons employed against a typical RRAG road march formation | |
| Probability of fire power kill ($P_{F/K}$) | | TBD |
| (U) Service Life | 10 years | TBD |

Note 1: (C) Proof target:



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Budget Activity: 4. Tactical Programs
Program Element: 0604607F, Wide Area Antiarmor Munitions (WAAM)

4. (U) Current Test and Evaluation (T&E): All Sensor Fuzed Weapon (SFW) testing to date has been conducted by the system contractor, Textron Defense Systems, and by the SFW System Program Office at Eglin AFB FL.

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| Prototype Demonstrations, Engineering Development | All Qtrs FY 87 and 1-2 Qtrs FY 88 | Oct 86 - Sep 87<br>Oct 87 - Feb 88 | Submunition structural problem found and corrected. Submunition tests with live warheads were successful. First ever weapon-level tests have verified sequence of events and pattern size using inert warheads. |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Contractor Demonstrations, Engineering Development | 2 Qtr FY 88 | Weapon-level tests with live warheads leading to Critical Design Review |
| Start Air Force Development Test and Evaluation | 3 Qtr FY 88 | 28 weapons to be tested |
| Start Air Force Initial Operational Test and Evaluation | 2 Qtr FY 89 | 36 weapons to be tested |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604617F — Title: Air Base Operability
DOD Mission Area: 225 - Air Warfare Support — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 16,324 | 11,953 | 17,018 | Continuing | N/A |
| 2621 | Rapid Runway Repair | 7,000 | 3,493 | 3,900 | Continuing | N/A |
| 2895 | Air Base Operability | 7,304 | 5,620 | 7,550 | Continuing | N/A |
| 3141 | Camouflage, Concealment, and Deception | 2,020 | 2,840 | 5,568 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Sustained airfield operations are a prerequisite for a successful air campaign. Base and theater commanders must have the capability and resources to defend their main or forward airfields and to return them to operational status after sustaining an attack. This program focuses on integrating numerous ongoing efforts and providing for full-scale development for selected systems.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 19,651 | 14,532 | 17,034 | Continuing | N/A |
| Other Procurement | 47,426 | 39,677 | 123,904 | Continuing | N/A |

EXPLANATION: (U) FY 1987 RDT&E funding was reduced by Air Force reprogramming. FY 1988 RDT&E funding was reduced by Congressional action. This will delay the start of development of the Contingency Airfield Lighting System (CALS) until mid FY 1988 and shift the start of CALS production to FY 1990. The Aircraft Ground Mobility System (AGMS) full-scale development will be delayed until FY 1989 and development of F-16 foreign object damage avoidance equipment, to be used in conjunction with the AGMS equipment, will not be started in FY 1988 as planned. FY 1988 Other Procurement funding was reduced by Congressional action.

Program Element: 0604617F Title: Air Base Operability
DOD Mission Area: 225 - Air Warfare Support Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | | | | | |
| PE 0102896F | 1,440 | 20 | 519 | Continuing | N/A |
| PE 0207595F | 0 | 309 | 3,137 | Continuing | N/A |
| PE 0207596F | 38,316 | 28,479 | 58,123 | Continuing | N/A |
| PE 0208007F | 127 | 3,685 | 15,201 | Continuing | N/A |
| PE 0401896F | 1,604 | 2,636 | 6,566 | Continuing | N/A |
| PE 0702896F | 5,939 | 2,275 | 2,866 | Continuing | N/A |
| Quantities | Not Applicable. | | | | |
| Military Construction: | | | | | |
| Funds | | | | | |
| PE 0207596F | 2,570 | 1,730 | 9,880 | Continuing | N/A |
| PE 0208007F | 0 | 0 | 5,070 | Continuing | N/A |
| PE 0401896F | 0 | 1,050 | 0 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: This program transitions the advanced development efforts in PE 0603307F, Air Base Operability Advanced Development, to Full-Scale Development. Procurement is executed through PE 0102896F, Base Operations, Defensive; PE 0207595F, Base Communications, Tactical Air Forces; PE 0207596F, Base Operations, Tactical Forces; PE 0208007F, Tactical Deception; PE 0401896F, Base Operations; and PE 0702896F, Base Operations (Logistics).

6. (U) WORK PERFORMED BY: Program contractors are BDM Corporation, McLean VA (Rapid Runway Repair); Technology Applications Incorporated, Falls Church VA (Air Base Operability); and Brunswick Corporation, Deland FL, and Durodyne Incorporated, Tucson AZ (Camouflage, Concealment and Deception). The in-house development organizations responsible for elements of the program are Armament Division, Eglin AFB FL; Aeronautical Systems Division, Wright-Patterson AFB OH; the Air Force Engineering and Services Center, Tyndall AFB FL; and the Air Force Weapons Laboratory, Kirtland AFB, NM.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2621, Rapid Runway Repair. This full-scale development program will provide the technology, procedures, and equipment to rapidly repair large, deep craters in runways and taxiways as well as smaller, pothole sized craters caused by bombs or other enemy munitions. These functions are critical path activities which must be

accomplished before an air base can return to combat operations. The major technical thrusts are: (1) Bomb Damage Repair - develop the materials, equipment, procedures, and manuals to repair a full spectrum of conventional munitions damage. (2) Surface Roughness Criteria - determine rough field tolerance of existing aircraft and, in turn, derive surface roughness criteria which minimizes repair time. Major areas of future effort include crater preparation equipment, an alternative for the liquid-polymer-concrete small crater-capping material, which has not performed as required in testing, and a folded fiberglass mat crater-capping system. Equipment in development or test for crater preparation includes an asphalt planer to reduce the amount of upheaved pavement to be removed (feasibility test completion in December 1986, expected to be followed by further development, operational test, and a production decision in FY 1989); a profilometer to quickly identify the limits of upheaved pavement and to control repair quality (breadboard available in October 1986 with development and test efforts continuing into FY 1989); and excavator enhancements to reduce operator training requirements. Development efforts of the polymer concrete repair technique have shown the current material will not perform as required. Alternative materials and equipment are under review for development. Work on the fiberglass mat crater-capping material will result in finalizing the specifications for an air transportable repair capability (need for Southwest Asia) for procurement in FY 1989.

B. (U) Project: 2895, Air Base Operability. A survivable base recovery communications system will enter full-scale development in FY 1988 following advanced development efforts in FY 1986 and FY 1987. The system will satisfy the critical need for quick and orderly transfer of damage information, air base status, and tasking information between recovery personnel and command units. Software needed to support base damage assessment, determine proper placement of a minimum operating strip to resume aircraft operations, provide chemical contamination warning, and emergency action message handling will be integrated to provide a complete decision-aid tool. Development of these capabilities will proceed in phases, with the initial products tested and ready for production in FY 1991. The survivable communications link will provide a major improvement for the first action on the critical path to restoring combat operations after an enemy attack, damage assessment. It will aid in the next action on the critical path, Explosive Ordnance Disposal (EOD). Improvement of today's 40-year old EOD approach is vital. A system to clear small anti-personnel/materiel mines will complete development in FY 1989. A Mobile Armored Reconnaissance/Operations Vehicle (MARV) has been selected from existing armored vehicles in production. The armored vehicle will be modified slightly to accommodate current EOD equipment and personnel and to carry a Standoff Munitions Disrupter (SMUD), yet to be developed. The SMUD system will provide a rapid capability to neutralize large unexploded ordnance. A competitive contract for full-scale development (FSD) of the SMUD will be awarded in FY 1988 to be completed in FY 1989. Advanced development of an F-16 ground mobility system was completed in FY 1986. Testing showed that further development was not warranted, and that alternative solutions must be pursued. Studies of generic mobility equipment for all aircraft were completed in FY 1987. Tradeoff studies of ACMS versus taxiway repair will be completed in mid FY 1988, with development to start no earlier than FY 1989. Development of a portable airfield lighting system to outline the Minimum Operating Strip and provide visual approach course and glide path guidance will begin in FY 1988, with FSD through 1989 and production initiated in FY 1990.

Program Element: 0604617F — Title: Air Base Operability

DOD Mission Area: 225 - Air Warfare Support — Budget Activity: 4 - Tactical Programs

C. (U) Project: 3141, Camouflage, Concealment, and Deception (CCD). This project embraces the full spectrum of CCD methods to mitigate the effectiveness of enemy attacks against airfields. The project includes development of aircraft decoys, atmospheric obscuration concepts, and sensor deception (optical and radio frequency). Contract award for F-15 and F-16 aircraft decoy development occurred in FY 1987. Operational testing of the decoys will be conducted in FY 1988 followed by a production decision. Development of radar reflective devices for deception of enemy aircraft radars will start in FY 1988 with testing completed in FY 1989. The development of lightweight camouflage nets, large area canopy shelters, large area smoke screen capability, and surface-to-air missile simulators is expected to begin in mid FY 1988. Development completion and testing of these items is expected in FY 1990 The development of false operating surfaces will begin in early FY 1989 and be completed in FY 1991. Efforts that will focus on capabilities for electronic, infrared, and ultraviolet sensor deception are addressed in CCD II. The FSD and CCD II will begin no earlier than FY 1991 as portions of the advanced development study funded in PE 0603307F, and delayed due to FY 1988 Congressional funding cuts, are completed. CCD II will continue into FY 1993 or beyond.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

PE: 0604617F

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604703F
DOD Mission Area: 255 - Air Warfare Support

Title: Aeromedical/Chemical Defense Systems
Budget Activity: 4 - Tactical Programs

1. (U) **RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)**

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 6,874 | 6,704 | 6,097 | Continuing | N/A |
| 2866 | Aeromedical/Chemical Defense Systems | 6,874 | 6,704 | 6,097 | Continuing | N/A |

2. (U) **BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** The Air Force has limited capability to treat and evacuate wartime casualties from a chemical or conventional warfare environment and no current means of improving this capability. This program will develop, produce and deploy field medical equipment/systems for the treatment and evacuation of wartime casualties in a chemical or conventional warfare environment. It will also provide tactical and strategic aeromedical evacuation systems and Air Force unique field medical treatment equipment (second and third echelon medical units) required to fulfill Department of Defense and Air Force needs.

3. (U) **COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)**

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 8,063 | 6,730 | 8,103 | Continuing | N/A |

EXPLANATION: (U) The FY 89 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) **OTHER APPROPRIATION FUNDS:** Not Applicable.

5. (U) **RELATED ACTIVITIES:** This program is coordinated and reviewed via the Joint Service Review Group for Chemical Warfare and by the Armed Services Biomedical Research and Evaluation Management Committee. Only efforts unique to the Air Force (Tactical and Strategic Aeromedical Evacuation and the Air Force Medical Four Echelon System) are addressed in this program. PE 0603231F, Crew Systems and Personnel Protection Technology, will transfer advanced development efforts of Air Force unique requirements to this program. In addition, a Memorandum of Agreement was established with the U.S. Army Medical Research and Development Command to jointly pursue some of these programs in accordance with the Joint Service Agreement. Internationally this program is coordinated through the NATO/Military Agency for Standardization. Air Force operational commands are involved throughout the development process.

6. (U) **WORK PERFORMED BY:** This program is conducted by the Aeromedical/Casualty System Program Office, Human Systems Division, Brooks AFB, TX. Integrated Logistics Support is provided by Air Force Logistics Command and the Air Force Office of Medical Support. The entire contract portion of the program is conducted by Essex Cryogenics of Missouri, St Louis, MO; Krug International, San Antonio, TX, and Dayton, OH; ILC Dover, Frederica, DE; Systems Research

Laboratories, Dayton, OH.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2866, Aeromedical/Chemical Defense Systems

A. (U) Project Description: This project develops medical equipment and systems for treatment and evacuation of wartime casualties in a chemical or conventional warfare environment. It also provides tactical and strategic aeromedical evacuation systems, blood transshipment capabilities, and field medical treatment equipment (second and third echelon medical units) to fulfill Department of Defense and Air Force operational requirements. The introduction of chemical warfare into a conventional conflict will significantly increase casualty rates and limit the effectiveness of the Air Force medical mission. Urgent requirements identified by the major commands for the treatment, evacuation and/or rapid return to duty of wartime casualties are the basis for the program. The ability to isolate the casualties from further chemical agent contamination, to allow medical personnel to render effective treatment under these conditions, and to adequately transport or rapidly return the casualties to duty are essential to the success of the Air Force medical mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 included the System Program Office's first program management responsibility transfer of the Electrical Cable Assembly Sets. These electrical cable (extension cord) sets allow the interface of medical equipment with onboard power of aeromedical evacuation aircraft. Award of production options for the Therapeutic Oxygen Manifold System and the Portable Therapeutic Liquid Oxygen System will provide the capability for medical teams to ventilate patients during aeromedical evacuation. Full scale development continued on the Survivable Collective Protection System-Medical (SCPS-M). Developmental Test and Evaluation of the SCPS-M was successfully completed on schedule in September 1987.

(2) (U) FY 1988 Program: The FY 1988 program will include operational test and evaluation of the Osan AB Hospital Contamination Control Area (CCA), SCPS-M and casualty coveralls. The Osan CCA, when installed and integrated with the existing hospital chemical-biological filtration system and utilities, will allow chemical decontamination and processing of both litter and ambulatory patients into the medical facility. The Osan CCA and its associated data package will be the prototype for development of other hospital designated CCAs. The SCPS-M will provide the capability to perform medical care on base, near areas of greatest casualty generation or population density, in both chemical and conventional warfare environments. Currently, the Air Force medical community must perform medical care off base in a chemically clean area. An on-base capability will result in faster treatment of casualties and a shorter return-to-duty time of minimally injured patients, eliminating the logistics, transportation, and security problems associated with the current off-base location. Full scale development will begin on Civil Reserve Air Fleet (CRAF) Aeromedical Evacuation (AE) Shipsets. The CRAF AE Shipsets provide the equipment necessary to configure 85 Boeing 767 and 30 McDonnell-Douglas 80 civilian aircraft to meet triservice needs for wartime aeromedical evacuation.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will include production of the Casualty Coveralls, the Survivable Collective Protection System-Medical (SCPS-M), the Chemically Hardened First Aid Kit and Chemical Warfare Equipment Cover. Full scale development will continue on the Civil Reserve Air Fleet (CRAF) Aeromedical Evacuation (AE) Shipsets. Full scale development will begin on the Transportable Blood Transshipment Center (TBTC). The Air Force has the lead to provide blood freezing, storage, and transshipment capability worldwide. Currently, blood can only be stored for 35 days. With TBTC, processed frozen blood can be received, re-iced, and stored for 21 years prior to shipment, greatly improving the capability of the Armed Services Blood Distribution System.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Survivable Collective Protection System-Medical (SCPS-M)-Development Contract Award | | July 1986 |
| (2) (U) Portable Therapeutic Liquid Oxygen System Production Decision | | November 1986 |
| (3) (U) Therapeutic Oxygen Manifold System Production Decision | | November 1986 |
| (4) (U) Osan AB Hospital Contamination Control Area-Development Contract Award | | February 1987 |
| (5) (U) Chemically Hardened First Aid Kit-Production Decision | | August 1987 |
| (6) (U) Chemically Hardened Bandage Cover-Production Decision | | January 1988 |
| (7) (U) Ambulatory Casualty Chemical Warfare Suit and Intravenous System-Production Decision | *(June 1987) | June 1988 |
| (8) (U) Civil Reserve Air Fleet Aeromedical Evacuation Kits-Development Contract Award | *(November 1987) | July 1988 |
| (9) (U) Patient Ventilator-Contract Award | *(October 1988) | Cancelled |
| (10) (U) Transportable Airborne Therapeutic Station Production Decision | *(August 1987) | January 1989 |
| (11) (U) Transportable Blood Transshipment Center-Development Contract Award | | January 1989 |
| (12) (U) SCPS-M Production Contract Award | | July 1989 |

*Date presented in FY 1988/89 Descriptive Summary.

(579)

(U) Explanation of Milestone Changes:

(7) (U) Ambulatory Casualty Chemical Warfare Suit production decision delayed due to correction of DT&E deficiencies.
(8) (U) The Civil Reserve Air Fleet Aeromedical Evacuation kits slipped 210 days due to failure to receive proposals after the first solicitation.
(9) (U) The Patient Ventilator program was cancelled due to funding reductions.
(10) (U) Transportable Airborne Therapeutic Station delay due to contractors development test and evaluation units failed testing.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604704F
DOD Mission Area: 225 - Air Warfare Support

Title: Common Support Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0* | 1,639 | 1,635 | Continuing | N/A |
| 2479 | Common Support Equipment Development | 0* | 1,139 | 1,135 | Continuing | N/A |
| 3759 | Air Force Office of Support Equipment Management (AFOSEM) | 0 | 500 | 500 | Continuing | N/A |

* FY 1987 funding was contained in PE 0604708F, Other Operational Equipment.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, tests, evaluates and fields improved flight line, base level, and depot level support equipment which is not available through commercial aviation or off-the-shelf procurement channels. Its goal is to limit proliferation, increase standardization, performance, availability, and reliability and maintainability, thereby reducing life cycle costs. Special needs of various theaters of operation, including those peculiar to the Rapid Deployment Forces, are addressed. This program will also develop software for planning tools such as the Support Equipment Acquisition Management System and the Support Equipment Master Plan, and automate the support equipment and other appropriate data bases to support planning and development activities. The project further implements the Air Force Office of Support Equipment Management objective to develop, support and promote the use of standardized support equipment and improve interoperability throughout the Air Force by automating MIL-HDBK-300 to facilitate its use by acquisition agencies in AFLC, AFSC and other military services.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 0* | 1,645 | 2,237 | Continuing | N/A |

EXPLANATION: (U) Higher Air Force priority programs caused adjustments to the FY 1988 and FY 1989 efforts.

* FY 1987 funding was contained in PE 0604708F, Other Operational Equipment.

4. (U) OTHER APPROPRIATION FUNDS: Other Procurement Funding Sources: BP 1200, Common Aerospace Ground Equipment related to Project 2479, Common Support Equipment Development and BP 3400, Contract Funds related to the project 3759, the Air Force Office of Support Equipment.

5. (U) RELATED ACTIVITIES: Close cooperation is maintained with other services via the Joint Logistics Commanders Panel on Support Equipment and this same cooperation is maintained with the Major Commands via the Aircraft Ground Support Equipment Working Group (AGSEWG), the Air Force Office of Support Equipment Management, the Air Force Crash Damaged or Disabled Aircraft Recovery Program Management Office and the Air Force Nondestructive Inspection Program Office. This program element was funded in FY 1987 and previous years in PE 0604708F, Other Operational Equipment.

6. (U) WORK PERFORMED BY: The top contractors are Libby Corporation, Kansas City, MO, Ingersoll-Rand Corporation, Woburn, MA, Teledyne Continental Motors, Mobile, AL, Modern Technologies Corporation, Dayton, OH and Synergy Inc., Washington DC. The in-house developing organizations are the Air Force Systems Command, Aeronautical Systems Division and the Air Force Acquisition Logistics Center, Air Force Office of Support Equipment Management, both organizations are located at Wright-Patterson AFB, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) PROJECT: 2479, Common Support Equipment Development. This project develops standardized flight line ground support equipment to fill a need for more effectiveness, Lower life cycle costs, and greater returns on investment than is provided by current support equipment. The project develops ground support equipment which meets the operational needs of both tactical and strategic forces which cannot be satisfied by AFLC through off-the-shelf commercial aviation ground support equipment. The Large Aircraft Start System (LASS) project will result in a replacement air cart for the unsupportable MA-1A air start cart. The Advanced X-Ray System (AXES) project will develop a rugged, high resolution x-ray system for field nondestructive detection of structural flaws, foreign substances, and corrosion in inaccessible or otherwise uninspectable components of aircraft, engines, and missiles. The Crash Damaged or Disabled Aircraft Recovery System (CDDARS) will acquire new stable, versatile lifting systems to provide the capability to safely recover all disabled or crashed aircraft from any terrain while minimizing time, manpower and support equipment. In addition CDDARS will impose no additional damage to recoverable airframes. The FY 1987 program completed design life testing and initial operational test and evaluation (IOT&E) of the Ground Power Generator (funded in PE 0604708F, Other Operational Equipment). IOT&E was also concluded on the Universal Aircraft Towbar (UAT) prototypes; the production option was terminated based upon a finalized life cycle cost and benefit analysis study. It was determined to be more economical to modify a towbar currently in the inventory than to procure the UAT. Using the Standard Hydraulic Test Stand (STAHTS) specifications previously developed, an industry-wide review of current technology and commercial aviation hydraulic system capabilities determined that the continued development of the STAHTS was no longer necessary. Commercial aviation hydraulic system and component technology has developed to the point that a "tailored specification" may now be used by AFLC to procure a test stand using the STAHTS guidelines, specifications and drawings. The FY 1988 program will conclude development effort on the STAHTS and transfer all data, specifications and drawings to AFLC. It will also initiate low level full scale development of the Advanced X-Ray System to include preparation of performance characteristics, specifications, and procurement documents such as the statement of work and request for proposals. The FY 1989 program will continue FSD of the Advanced X-Ray System with contract award for building of the prototype scheduled for the first quarter and initiation of design life testing in the third quarter. The program will also initiate preliminary investigation of the development needs for the Crash Damaged or Disabled Aircraft Recovery System (CDDARS) common ground support equipment requirements. The cost estimates for this program

were developed using category IV planning methods and the RCA Cost Model. This is a continuing program for the development of flight line, base level, and depot level aircraft ground support equipment.

B. (U) Project 3759: Air Force Office of Support Equipment Management. This project will develop the software necessary to automate MIL-HDBK-300 and the common hand tool lists. This automation will include line drawing capability, interchangeable substitute listings and an in-depth list of performance and physical characteristics for each item of support equipment listed. This system will provide acquisition managers the ability to screen proposed support equipment recommendations for comparison with existing items. The automated handbook will interface with the Air Force Equipment Management System (AFEMS) and be able to automatically extract data from existing tables of allowance and reliability and maintainability records. Each item of support equipment entered will have a life line which indicates its planned life expectancy, previous or planned production buys, and programmed replacement criteria. It will also develop algorithms which interface with historical data for use by the system program office to prepare the support equipment budget. This is an FY 1988 new start project to develop software for automated support equipment management tools. The FY 1988 program will correct current software deficiencies and develop a series of automated enhancements for existing and maturing systems such as a data quality assurance system in MIL-HDBK-300, a user oriented data problem reporting system, a query and/or software problem reporting system, an interface with the contracting file system (J041), future life line data for each item of support equipment in MIL-HDBK-300, a program which will extract and enter SERD information from the product division SERD tracking system, and a system which will automatically extract data from existing tables of allowance and reliability and maintainability records. The program will also automate both common hand tool lists and develop line drawings for each item of support equipment in the data base. The FY 1989 program will develop a formal automated testing system for the support equipment data base and MIL-HDBK-300, develop the capability to display the program using color screen graphics, develop an analysis program for support equipment comparison to determine life cycle cost drivers, develop historical data and algorithms for use by the system program office during budget preparation, and conduct a feasibility study on the inclusion of commercial support equipment data into the automated MIL-HDBK-300 and Air Force support equipment data base. The cost estimates for this program were developed using category IV planning methods.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604706F  
DOD Mission Area: 225 - Air Warfare Support

Title: Life Support System  
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands):

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 14,702 | 12,568 | 16,914 | Continuing | N/A |
| 412A | Life Support Systems | 12,239 | 10,103 | 10,266 | Continuing | N/A |
| 3111 | Aircraft Mishap Prevention Program | 1,608 | 50 | 448 | 3,210 | 8,805 |
| 2952 | F-111 Cluster Parachute | 855 | 2,415 | 6,200 | 2,190 | 14,660 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the only Air Force program element devoted to engineering development of life support equipment and contains a number of joint service endeavors. Project 412A provides for centralized management and full-scale development of life support equipment and subsystems necessary to assure functional capability of aircrews throughout all mission environments and to enhance safe escape, descent, survival, and recovery in emergency situations. It also provides for development, test, and standardization of emergency equipment and protective clothing and devices for non-flying personnel. Project 3111 will develop a data base and management information system to reduce loss of aircrew lives and aircraft due to human error. Project 2952 is a safety modification to the parachute system of the F-111 Crew Escape Module to lower descent velocity and thereby reduce the frequency and severity of spinal injuries to ejecting crew members.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 14,879 | 12,617 | 15,730 | Continuing | N/A |

EXPLANATION (U): $3.2 million was added in FY 89 to correct a funding disconnect in Project 2952, F-111 Cluster Parachute. A later reduction of $2.0 million in FY 89 reflects revised fiscal guidance. This reduction delays initial operational capability of the Aircraft Mishap Prevention Program (Project 3111) from FY 1991 to FY 1992.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: There are several program elements contribute to full-scale development of life support equipment, including: PE 0602201F, Aerospace Flight Dynamics; PE 0602202F, Aerospace Biotechnology; PE 0603211F, Aerospace Structures/Materials; PE 0603231F, Crew Systems and Personnel Protection Technology; PE 0602723A, Clothing, Equipment and Shelter Technology; PE 0604204A, Air Mobility support Equipment; PE 0602241N, Ejection Seat Bio-Dynamics; PE 0602758N, Biomedical Technology; and PE 0603216N, Mission Oriented Clothing and Devices. All efforts within this

program are closely coordinated with the other services via a formal Tri-Service steering committee, established in 1980 to promote standardization and prevent duplication of effort.

6. (U) WORK PERFORMED BY: Air Force Systems Command's (AFSC) Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH, manages Project 412A. Support is also provided by other Service organizations. ASD had 16 major contractors in FY 1987, including Douglas Aircraft Company, Long Beach, CA; Motorola, Phoenix, AZ; and Gentex, Carbondale, PA. The total value of Life Support R&D contracts is approximately $12 million. AFSC's Aerospace Medical Division, Brooks AFB, TX, manages Project 3111. Battelle Columbus Laboratories, Columbus, OH, was one of three project contractors in FY 1987. ASD manages Project 2952, but the work is performed by Air Force Logistics Command's (AFLC) Sacramento Air Logistics Center (ALC), McClelan AFB, CA. General Dynamics Corporation, Fort Worth, TX is one of the two contractors, and the project is also supported by the National Aeronautics and Space Administration, Dryden Flight Research Facility, Edwards, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3111, Aircraft Mishap Prevention Program (AMPP). This project develops and demonstrates a data base and information management system to reduce loss of aircraft and aircrew lives due to human factors or errors. It establishes an Air Force-wide mishap and near-mishap reporting system tailored to provide detailed data on human factors problems for direct command-level access to aircraft system project offices for design change recommendations, to the R&D and engineering community for identifying R&D needs to the laboratories, and to the safety community for compiling mishap statistics. In FY 1987 the AMPP Acquisition Plan was approved. Further activities will be postponed until FY 1989, due to funding constraints. A full-scale development contract will be awarded in FY 1990, and the primary activities in that year will be the refinement and update of the prototype software, data collection, and the development of user application scenarios. These tasks will extend into FY 1991. Also in FY 1991, the development of an Operations Impact Model to track implemented solutions and to provide a measure of return-on-investment will take place. In-house training programs will be developed and development test and evaluation conducted. A system demonstration, as well as operational test and evaluation will occur in FY 1992. Prior to a decision to transition AMPP to operational use, a fielding demonstration of the system at the command level and an analysis of program payoff will be made. In FY 1993, the functioning program will be transferred to the Air Force Inspection and Safety Center, Norton AFB, CA.

B. (U) Project: 2952, F-111 Cluster Parachute. The goal of this project is to reduce the frequency and severity of spinal injuries incurred by ejecting F-111 crew members when the Crew Escape Module (CEM) impacts the ground. This is achieved by replacing the current single-canopy parachute on the CEM by a cluster of three parachutes, thereby lowering impact velocity. Prior efforts included the selection of a cluster parachute as the design solution, detailed design of the cluster parachute, and proof-of-design testing. FY 1987-1989 work consists of CEM-parachute integration and testing. FY 1987 efforts included captive crew module tests at Sandia National Laboratories, Albuquerque, NM, air drop tests at the Air Force Flight Test Center, Edwards AFB, CA, and rocket sled ejection tests at Holloman AFB, NM. Both the air drop and ejection tests will continue throughout FY 1988 and FY 1989, followed by a production contract for modification kits for the F-111/FB-111 CEM.

Program Element: 0604706F
DOD Mission Area: 225 - Air Warfare Support

Title: Life Support System
Budget Activity: 4 - Tactical Programs

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 412A, Life Support Systems.

A. Project Description: Provides centralized development of Air Force Life Support equipment and subsystems as well as selected items of joint service equipment. Satisfies operational command requirements for improved Life Support equipment to maximize aircrew capability throughout all environments, and to enhance safe escape, descent, survival, and recovery in emergency situations. Also provides for development, test, and standardization of emergency equipment and protective clothing and devices for non-flying personnel.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In FY 1987, the Aircrew Anti-Drown System entered FSD and Initial Operational Test and Evaluation (IOT&E) efforts began. FSD of a follow-on anti-G valve also began. The Positive Pressure Breathing (PPB) System was demonstrated on the F-16. Both the Cold Weather Flying Boot and the Noise Reduction Earcup entered FSD. The Cold Weather Sleeping Bag and the Vacuum-Packed One-Man Life Raft underwent IOT&E, and production specifications were finalized. The procurement request package for the Multi-Place Life Raft was completed, and FSD began. The Automatic Inflation Modulation (AIM) Parachute and the ARS underwent sled testing with the ACES II, and the development of a Restraint Emergency Release (RER) System for the ACES II began. Aircrew Laser Eye Protection entered FSD. Planning began for two important new projects: the Universal Seawater Activated Release System (SEAWARS), a seawater activated release system for man-carried parachutes; and the Aircrew Integrated System (AIS), a transition into FSD of the Tactical Life Support System (TLSS), which integrates all crew-mounted life support items in a single package.

(2) (U) FY 1988 Program: The Aircrew Anti-Drown System will complete FSD and enter production. FSD of a follow-on anti-G valve will be completed, and OT&E will take place. IOT&E will be conducted and a production decision made for the Cold Weather Flying Boot. OT&E will be completed and a production contract awarded for the Noise Reduction Earcup. OT&E of the Multi-Place Life Raft will begin. Production of the AIM Parachute and the ACES II ARS will begin. Testing of the RER System for the ACES II will be conducted, leading to a production decision. Planning for the AIS and Universal SEAWARS will continue.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, the Aircrew Anti-Drown System will attain initial operating capability. Other ongoing developments will continue. AIS and Universal SEAWARS will enter FSD. Cost estimates are based on detailed implementation plans prepared by field agencies each year and are a mixture of fixed price contracts, grass roots, and parametric estimates. This program contains 24 different tasks, including cost categories I, II, III, and IV.

(4) (U) Program to Completion: This is a continuing program. Full-scale development efforts will be initiated based on the Life Support Master Development Plan, which identifies and integrates Life Support development efforts for the next 10 years.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS:

(U) Automatic Inflation Modulation (AIM) Parachute: The AIM Parachute is a joint US-Canadian venture to improve the performance of the Advanced Concept Ejection Seat (ACES) II through development of a parachute which has improved reliability and the capability to deploy at higher speeds, thereby lowering the minimum altitude for safe ejection. The cooperative agreement between the US and Canada provides for 50-50 sharing of the cost of parachute development, which began in 1978 and was completed in November 1982 at a total cost of $1.2 million for the US and $0.6 million for Canada. (Costs were not equal because the US contracted for some unique requirements.) The US pays the full cost of the subsequent ACES II integration and system-level qualification, which were contracted for through a modification to the original 1978 parachute development contract. The contractor is Irvin Industries Canada, Ltd., Fort Erie, ON, although the Life Support System Program Office contracts directly with the Canadian Government (Canadian Commercial Corporation, Ottawa, ON). US costs for ACES II integration and system-level qualification, which began in March 1984, have been $0.3 million in FY 1984, $0.3 million in FY 1985, $0.8 million in FY 1986, and $0.4 million in FY 1987. Projected costs to completion are $0.1 million in FY 1988. The cooperative agreement also provides for co-production. Specifically, if the Canadian bid is within 117 percent of the winning US industry bid, Canada will get half the production, up to 13,000 units annually.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604708F
DOD Mission Area: 225 - Air Warfare Support

Title: Other Operational Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 12,947 | 7,635 | 6,044 | Continuing | N/A |
| 2054 | Aerospace Facilities Engineering Development | 2,758 | 2,135 | 890 | Continuing | N/A |
| 2479 | Common Support Equipment Development | 898 | 0* | 0* | Continuing | N/A |
| 2505 | Aircraft Fire Fighting, Suppression and Rescue | 1,278 | 1,245 | 988 | Continuing | N/A |
| 2674 | Tactical Shelters | 1,493 | 1,873 | 966 | Continuing | N/A |
| 2783 | Ground Power Generator Development | 2,057 | 0 | 0 | 0 | 35,400 |
| 3080 | Generic Integrated Maintenance Diagnostics | 4,463 | 2,382 | 3,200 | Continuing | N/A |

* Beginning in FY 1988, funding for Project 2479, Common Support Equipment Development, is in PE 0604704F, Common Support Equipment.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, tests, and evaluates improvements to tactical shelters, fire fighting equipment and methods, pollution monitoring and abatement equipment, air base facilities, and aircraft diagnostics/test systems. Special needs of various theaters of operation, including those peculiar to the Rapid Deployment Forces, are addressed.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 13,753 | 6,987 | 6,748 | Continuing | N/A |

EXPLANATION: (U) The change in FY 1988 was an addition of $648,000 to project 2054 to support environmental restoration research efforts. The change in FY 1989 was caused by a cost-cutting reduction of $704,000. As a result, in project 2054, efforts to improve post-attack facility reconstitution methods will be discontinued, as will

full-scale demonstration of promising technologies to strip volatile organic compounds (VOC) from the exhaust of industrial processes. In project 2505, the program to develop improved materials and equipment for fighting POL tank-farm fires and the IOT&E of a remote-controlled fire fighting vehicle will be postponed indefinitely. In project 2674,the loss of funds will cause cancellation of the program to develop add-on armor for ballistic protection of shelters, as well as termination of USAF participation in two US Army programs to develop new types of shelters.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PE 0603723F, Civil and Environmental Engineering Technology, provides advanced development for projects 2054 and 2505. Close cooperation is maintained with other services via the Joint Logistics Commanders Panel on Support Equipment, the Joint Committee on Tactical Shelters and the Joint Services Civil Engineering Research and Development Coordinating Group.

6. (U) WORK PERFORMED BY: The primary contractors are University of New Mexico Research Institute, the Department of Energy, Idaho Operations Office and AMETEK, Inc., Offshore Research and Engineering Division, Santa Barbara, CA (for project 2505, Fire Fighting, Suppression and Rescue and project 2054, Aerospace Facilities Engineering Development). The in-house developing organizations are: for project 3080, the Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH; for projects 2054 and 2505, the Air Force Engineering and Services Center, Tyndall AFB, FL; and for project 2674, Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. In FY 1987 the GIMADS contract was awarded to General Dynamics-Ft Worth with subcontactors that included TRW, Hughes Aircraft Co., Marconi, General Electric, Rockwell International, Bell Helicopter, General Dynamics Electronics, and Giordano Associates.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2054, Aerospace Facilities Engineering Development. This project addresses the development of equipment, materials, and procedures to improve the operational effectiveness of aerospace facilities and to assure the Air Force meets Environmental Protection Agency standards. In 1987, NATO semihardened facilities design criteria were completed and criteria were validated for asphaltic concrete recycling. Full-scale development of the Radioluminescent Portable Airfield Lighting was completed. In FY 1988, non-destructive testing for pavements and evaluation of existing VOC control technologies will conclude, fuel additive tests for reduction of Hush-house emissions will be initiated, and the carrying capacity of runways will be evaluated. Also, simulator applications for Base Civil Engineering training will be determined. FY 1989 funding will not be sufficient to undertake new initiatives; therefore, the project will only include continuation of programs already started. Development of a multi-equipment training simulator for heavy equipment operators will proceed, and the validation of the soft-soil model for runway operations will be completed.

B. (U) Project: 2505, Fire Fighting, Suppression and Rescue. This project develops improved firefighting, suppression and rescue, equipment, materials, and methods to increase Air Force fire protection effectiveness, mobility, and wartime readiness. In 1987, development of the lightweight rescue tool for emergency aircraft entry was finalized and acquisition was initiated. Development of a two-hour firefighter rebreather was also completed, as was full-scale testing of a lightweight firefighter ensemble. Development of an improved TAF rescue vehicle was initiated. In 1988, development will be completed for the lightweight ensemble and for an automatic fire suppression system for base housing. Evaluation of the TAF rescue vehicle will continue, and development of a fire fighting vehicle simulator will be initiated. Lastly, development of an automatic fire suppression system for hardened aircraft shelters (HAS) will proceed. In FY 1989, reduced funding will permit continuation of only the HAS fire suppression system, which must be available for the programmed USAFE FY 90 and FY 91 buys.

C. (U) Project: 2674, Tactical Shelters. This project provides for joint service development and acquisition support of tactical shelter systems, with the intent to improve and standardize shelter designs. In 1987, contracts were awarded for development of an ISO loading jack system and for FSD of an ISO adapter pallet. Efforts continued on development of variable speed environmental control units, and on a three-year study of chromate vs. non-chromate paints and primers. A joint USAF/US Army/USN/USMC reliability/maintainability documentation program was also initiated. Work on the add-on armor program and on EMP/EMI protection continued, and design was begun on an EMP simulator. Several joint programs were initiated and contracts awarded for development of shelters for specific uses, such as for the HMMWV and CUCV shelters. In FY 1988, development and testing of the ISO adapter pallet will be completed, while work will continue on the remaining FY 87 projects. New initiatives will include finite element analyses of structural components to determine shelter material strength requirements, a tactical shelter market survey and report, and award of a contract to develop promising new shelter materials. In FY 1989, there will be no new initiatives. Efforts in the reliability/maintainability area will continue, as will testing of the paints and primers and development of the variable speed ECU. Evaluation of the jacking system and the adapter pallet will conclude.

D. (U) Project: 3080, Generic Integrated Maintenance Diagnostics (GIMADS). GIMADS will provide generic, expandable, integrated maintenance diagnostics methods and standards. Early demonstration of GIMADS on the B-1B will increase the experience base. The overall purpose is to provide cost effective capabilities to the weapon system designer to build-in 100 percent fault-detection and isolation to the line-replaceable-unit/module and provide maintenance techniques and retrofit capability for Air Force weapon systems. The FY 1987 program awarded GIMADS full scale development contract to General Dynamics-Ft Worth. The GIMADS contract partitions the development into 11 integration process tasks and 11 technology application tasks to develop a generic diagnostic methodology. A close working relationship is being developed with the Navy through the Panel on Integrated Diagnostics of the Joint Logistics Commanders' Joint Policy Coordinating Group for Logistics Research, Development, Test, and Evaluation. The GIMADS program implements recommendations of the National Academy of Science's Air Force Studies Board Summer Study (1985), and capitalizes on products from the National Security Industrial Associations's (NSIA) Working Group on

Integrated Diagnostics, and supports Office of the Secretary of Defense (OSD) chaired activities on fault isolation and diagnostics. In FY 1988, the project will continue with incremental implementation of the techniques and methodologies to weapon system acquisitions. In FY 1989, techniques and methodologies for non-electronics fault isolation will be redefined and integrated with continuing application to weapon system acquisitions.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604715F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 16,464 | 11,288 | 5,144 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the full-scale development of the Department of Defense Base and Installation Security System, a standardized set of components, interfaces, and methodology for creation of exterior physical security systems, by accomplishing full-scale development tasks in three functional areas: detection, command and control and imaging. A Department of Defense need exists for a family of standardized modular equipment which can be integrated into system configurations to provide a level of security in consonance with the deployment mode, threat level and sensitivity of the asset being protected. The resulting security equipment increases the capability of the security forces to detect and intercept terrorists and permits increased mobility of the forces for better utilization of existing manpower.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 16,536 | 11,332 | 5,148 | Continuing | N/A |
| Other Procurement | 0 | 8,288 | 8,404 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Other Procurement (0207589F) | | | | | |
| Funds | 0 | 9,713 | 10,972 | Continuing | N/A |
| (Spares funds not included) | | | | | |
| Quantities | Not Applicable | | | | |

5. (U) RELATED ACTIVITIES: Advanced development tasks including equipment prototypes, development of technology base, and development testing are accomplished under Program Element 0603714F, Department of Defense Physical Security Equipment-Exterior (Advanced Development). Procurement of physical security equipment is accomplished using Other Procurement-Air Force funding under Program Element 0207589F, Air Force Physical Security Systems. The Base and Installation Security System equipment will be designed for interoperability with the Army interior security system (facility intrusion detection system) and the Army tactical sensor system (remotely monitored battlefield sensor system) Management oversight of the physical security equipment program is provided by the Department of Defense Physical Security Equipment Action Group with the Chairperson residing in the Office of the Under Secretary of Defense for Acquisition.

PE: 0604715F

6. (U) WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, Electronic Systems Division, Hanscom AFB MA. Department of Defense agencies performing development tasks are: Rome Air Development Center, Griffiss AFB NY; Army Mobility Equipment Research and Development Command and Army Night Vision Laboratory, Fort Belvoir, VA; Army Waterways Experimental Station, Vicksburg, MS; Naval Ocean Systems Center, San Diego, CA; and the Naval Coastal Systems Center, Panama City, FL. In addition to these Defense agencies, the Department of Energy/Sandia National Laboratory, Albuquerque, NM performs development tasks, and Analytical Systems Engineering Corporation assists with systems engineering support and integration tasks. Contractors presently developing security systems under this effort include E-Systems, Fairfax, VA; Computing Devices Company, Ottawa, Canada; Magnavox Electronics Systems Company, Ft Wayne, IN; Teledyne Controls Corporation, Los Angeles, CA; Sanders Association, Nashua, NH, and ISC Corporation, Lancaster, PA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604715F, DOD Physical Security Equipment-Exterior

A. (U) Project Description: This program responds to Secretary of Defense direction contained in Department of Defense Directive 3224.3, 1 December 1976, which designates the Air Force as executive agency for the development of standardized exterior physical security equipment and systems for the protection of bases and installations. This program will provide pre-production equipment and subsystems, thorough test and evaluation, and production specifications for the Base and Installation Security System equipment for the four Services. The engineering development tasks consist of optimization of the overall system configuration through conduct of component, subsystem, and system testing, and preparation of production specifications. The total Base and Installation Security System objectives are to provide a capability for high level security, against all threat levels, for resources in the three deployment modes: permanent, semi-permanent and mobile. Facilities and developments of other Services, government agencies, and commercial industries will be used to the maximum to insure that duplication of effort is avoided.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: This program provided for continued full-scale development of a number of sensor efforts. Development of video storage system continued. The video storage system is designed to store television images of intrusion attempts when more than one attempt is made. The development of the Scope Shield Communication System, to provide a narrow band mobile secure voice communication capability, and FOLPEN were continued in FY 1987. The tactical sensor program, which will develop and integrate sensors for use along external perimeters in high threat locations was initiated. The sensors would be employed along avenues of most likely approach of a hostile terrorist group attempting to penetrate a protected area.

Program Element: 0604715F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

(2) (U) FY 1988 Program: Full-scale development Radar Airborne Intrusion Detection System (RAIDS)program will be initiated in FY 1988. In addition to these efforts, the tactical sensor program will be continued. The Category III, budgetary, cost estimate is based on inputs from various government agencies performing these development efforts, and was updated in September 1987.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full-scale development of the RAIDS and the Tactical Sensor program will continue through FY 1989. The Category III, budgetary, cost estimate is based on inputs from various government agencies performing these development efforts and was updated in September 1987.

(4) (U) Program to Completion: This program will provide a family of modular electronic equipment, capable of being integrated in various system configurations to meet Department of Defense and Service requirements for physical security. As requirements for exterior physical security are validated, development tasks will be assigned to the Air Force by the Under Secretary of Defense for Research and Engineering to satisfy the requirement. This is a continuing program.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Foliage Penetration (FOLPEN) Radar Contract Award | October 1985 |
| (2) (U) Scope Shield Contract Award | March 1986 |
| (3) (U) Radar Airborne Intrusion Detection System (RAIDS) Contract Award *(February 1987) | May 1988 |
| (4) (U) FOLPEN Development Completion | October 1988 |

*Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Change:

(3) (U) RAIDS contract award slipped to aggregate all US Government requirements

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: None

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604725F
DOD Mission Area: 344 - Tactical Command and Control

Title: Combat Identification Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 8,848 | 34,864 | 107,196 | Continuing | N/A |
| 2597 | Noncooperative Identification Subsystems* | 1,000 | 0 | 0 | N/A | N/A |
| 2598 | Mark XV USAF Unique Development ** | 4,566 | 1,200 | 6,000 | Continuing | N/A |
| 2751 | Indirect Identification Subsystem | 3,282 | 10,430 | 26,000 | Continuing | N/A |
| 3592 | Mark XV Tri-Service Core Development *** | 0 | 21,300 | 60,196 | Continuing | N/A |
| 3756 | TACS NCTR | 0 | 1,934 | 15,000 | Continuing | N/A |

* FY 1988-1992 funding for Project 2597 transferred to PE 0603742F.
** Project 2598 previously named Cooperative Identification Systems.
*** Project 3592 added to identify Mark XV Tri-Service Core Development funding.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program element is to accomplish engineering development of systems that will provide reliable [ ] in all-weather and hostile electromagnetic countermeasures environments. This program is necessary because the [ ] demands that we engage the enemy at [ ] which is a prerequisite for such engagements [ ]. The [ ]

3. (U) COMPARISON WITH FY 1988/FY1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 8,908 | 44,930 | 127,599 | Continuing | N/A |

EXPLANATION: (U) FY 1988 reduction reflects Congressional reduction. Project 3592 funding in FY 1988 and FY 1989 reflects Army and Navy funding transferred to the Air Force for the Mark XV IFF Full Scale Development Core program. $20.4M reduction in FY 1989 reflects the Air Force decision to continue the Mark XV IFF Demonstration/Validation program for additional risk reduction activities, and conclusion of NATO negotiations which will delay FSD initiation.

Program Element: 0604725F  Title: Combat Identification Systems
DOD Mission Area: 344 - Tactical Command and Control  Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: Not applicable

5. (U) RELATED ACTIVITIES: Work accomplished under this program element is part of an integrated Tri-Service effort to improve United States identification capabilities worldwide. Related activities include: Program Element 0603742F, Combat Identification Technology; Program Element (PE) 0603790F, NATO Cooperative RDT&E; PE 0603790A, NATO Cooperative RDT&E; PE 0603790N, NATO Cooperative RDT&E; PE 0603267N, NATO Future Identification System; PE 0603515N, Advanced Identification Techniques; PE 0603706A, Identification Friend or Foe (IFF) Developments; PE 0604211N, Air Traffic Control Radar Beacon System/Mark XII; and PE 0604709A, IFF Equipment. Coordination and integration of the various activities under these program elements are accomplished through the Air Force led Tri-Service, Combat Identification System Program.

6. (U) WORK PERFORMED BY: The Mark XV IFF program is managed by the Tri-Service, Combat Identification System Program Office (CISPO) at the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH. The Indirect Subsystem program is managed by the Combat Identification System - Indirect Subsystem program office (CIS-ISS) at Electronic Systems Division, Air Force Systems Command, Hanscom Air Force Base, MA. Support is also provided by the MITRE Corporation, Bedford, MA and the Electromagnetic Compatibility Analysis Center, Annapolis, MD. Additionally, the following contractors are currently engaged in work under this program: Allied-Bendix Communications Division, Baltimore, MD (project 2598); and Texas Instruments, Dallas, TX (project 2598).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2598 Mark XV USAF Unique Development. This project funds the Air Force Mark XV IFF unique full scale development (FSD), testing, and integration of USAF-unique engineering development models (EDM) of the Mark XV system, derived from the common Tri-Service EDM developed in the Mark XV common FSD program funded by Project 3592. Prior year efforts funded initial preparations for the common FSD program, testing of the Demonstration/Validation Advanced Development Models, and the analytical efforts supporting NATO waveform negotiations. In FY 1988 this project supported the conclusion of the Demonstration/Validation test program and FSD preparations. In FY 1989, this project will support continued risk reduction efforts, directed by the USAF, to reduce total program costs and to conclude the NATO negotiations on the new IFF waveform. Baseline of this waveform is necessary to reduce the technical risk in FSD.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2751 Indirect Identification Subsystem.

A. Project Description: This project involves the development of techniques to use [

reliable means of [ ] weapon systems at distances that [ ] This project was established since a [ ] is needed to limit our

PE: 0604725F



(596)

forces' exposure to while still taking advantage of our own No such reliable means for providing this identification exists today. In fact, because of associated with all known identification techniques, the required can only be provided through the effective use Prior year demonstrations validated the feasibility of using data to improve the overall identification process in the Ground Tactical Control System (TACS).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In FY 1987, the Indirect Subsystem (ISS) program office conducted and completed an evaluation of passive identification sensor technologies/programs within all three Services, for applicability to ISS FSD requirements. In addition, preparations for full scale development (FSD) were started to suppport a 3 Qtr FY 1988 start.

(2) FY 1988 Program: In late FY 1988, the ISS program began the FSD to incorporate the ISS fusion and processing algorithm into the Modular Control Equipment (MCE). Interface specifications for into the MCE will be completed.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The first phase of hardware development of ESM sensor for begins in 3 Qtr FY 1989. This ESM sensor program will provide The FSD program for the MCE ISS fusion algorithm program concludes.

(4) Program to Completion: Testing of this ISS fusion algorithm will be conducted during FY 1990, with MCE incorporation scheduled for FSD of the ESM sensor (Phase 1) completes in 4 Qtr FY 1991, Testing will occur during FY 1992, and Production is scheduled for 2 Qtr FY 1993. Initial deliveries to the field will occur in 1 Qtr FY 1995. Phase 2 of the ESM sensor FSD program will design, test, and integrate into the Phase 1 ESM sensor system. ESM Sensor FSD (Phase 2) begins in 1 Qtr FY 1993, testing will begin in 2 Qtr FY 1994, and Production of Phase 2 modification kits and hardware begins in 3 Qtr FY 1995.

C. (U) Major Milestones:

| | | | |
|---|---|---|---|
| (1) | (U) | ISS Fusion algorithm FSD start | 3 Qtr FY 1988 |
| (2) | | ISS Fusion/MCE incorporation | |
| (3) | (U) | ESM Sensor (Phase 1) FSD start | 3 Qtr FY 1989 |
| (4) | (U) | ESM Sensor (Phase 1) Production start | 2 Qtr FY 1993 |
| (5) | (U) | ESM Sensor (Phase 2) FSD start | 1 Qtr FY 1993 |
| (6) | (U) | ESM Sensor (Phase 2) Production start | 3 Qtr FY 1995 |

Program Element: 0604725F    Title: Combat Identification Systems
DOD Mission Area: 344 - Tactical Command and Control    Budget Activity: 4 - Tactical Systems

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3592 Mark XV Tri-Service Core Development.

A. (U) Project Description: This project funds the Tri-Service (Air Force led) FSD core effort under the Combat Identification System (CIS) Program, to evolve comprehensive and balanced improvements to U.S. identification capabilities worldwide. For these improvements to have maximum effectiveness they must be interoperable with the identification capabilities of U.S. allies. To this end the United States cooperated with the other NATO nations to reach agreement on the basic operating characteristics (e.g., signals-in-space) of future identification equipment. Ongoing work in this project completes the advanced development of a direct, cooperative identification sysem (i.e., use of cryptographically secure questions and answers), called the Mark XV, to replace the aging Mark XII system. The Mark XV is the U.S. candidate for the NATO Identification System's Direct Subsystem. The future thrust of this project is the full scale development design, integration, and testing of engineering development models of the Mark XV system on the Tri-Service Core Platforms (F-15, F-18, Hawk, Aegis,and Spruance). The results of such tests supports the basis for validating the interoperability agreement with NATO and eventual preparations for low rate production.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Nct Applicable.

(2) (U) FY 1988 Program: The FY 1988 request supported the completion of the Demonstration/Validation laboratory and flight testing phase (Advanced Development). The program continued to work toward the final technical agreement on the system's waveforms and frequencies with our NATO allies. This agreement was planned to ocuur in early FY 1988, but additional analysis has been required and as a result, the final agreement should occur in late FY 1988. Preparations for full scale development contractual solicitation, and Milestone II were begun. In addition, the program has initiated additional risk reduction efforts focused on reducing total program costs (RDT&E, Procurement, O&S).

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Additional flight testing will be conducted to baseline the performance of both the current Mark XII IFF and the Mark XV IFF Advanced Development Models. Continued investigations into additional risk reductions efforts to reduce total program costs will conclude. The Milestone II decision is planned for 2 Qtr FY 1989. Initiation of the full scale development contract will occur immediately thereafter.

(4) (U) Program to Completion: Design and integration of Mark XV engineering developemnt models into the Tri-Service Core platforms will occur from 3 Qtr FY 1989 to 2 Qtr FY 1992. A Tri-Service Combined Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) will occur in in two phases from 2 Qtr FY 1992 to 4 Qtr FY 1994. Milestone IIIA will be in 1 Qtr FY 1994. Low Rate Initial Production (LRIP) will initiate in 2 Qtr FY 1994 and complete in 2 Qtr FY 1996. Full Rate Production will commence in FY 1996.

PE: 0604725F

Program Element: 0604725F
DOD Mission Area: 344 - Tactical Command and Control

Title: Combat Identification Systems
Budget Activity: 4 - Tactical Systems

C. (U) Major Milestones:

| | | | |
|---|---|---|---|
| (1) | (U) | FSD Request for Proposal release | 3 Qtr FY 1988 |
| (2) | (U) | FSD Source Selection completion | 1 Qtr FY 1989 |
| (3) | (U) | Milestone II decision (DAB II) | 2 Qtr FY 1989 |
| (4) | (U) | DT&E/IOT&E start | 2 Qtr FY 1992 |
| (5) | (U) | Milestone IIIA (DAB IIIA) | 1 Qtr FY 1994 |
| (6) | (U) | LRIP start | 2 Qtr FY 1994 |
| (7) | (U) | Milestone IIIB decision (DAB IIIB) | 3 Qtr FY 1995 |
| (8) | (U) | Full Rate Production | 3 Qtr FY 1996 |

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3756 Tactical Control System Noncooperative Target Recognition (TACS NCTR).

A. Project Description: This project was established since the Ground Tactical Control System (TACS) lacks means of In fact, because of the required can only be provided through the effective use of a This project specifically involves the development of techniques to use an existing radar. The focus of this project is to use radar. This will provide the capability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable.

(2) FY 1988 Program: This project commences, in late FY 1988. The FY 1988 request supports the integration studies and analyses necessary to baseline radar.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 request supports the intiation of full scale development radar. Engineering development of minor hardware modifications and software coding will take place.

(4) **Program to Completion:** [ ] and the minor hardware changes will be completed by the [ ] Testing of the [ ] radar with the [ ] will occur in [ ] Deployment of this capability to the field units will begin in [ ]

C. (U) **Major Milestones:**

| | | |
|---|---|---|
| (1) | [ ] engineering starts | 1 Qt FY 1989 |
| (2) | [ ] starts | [ ] |
| (3) | [ ] testing with [ ] radar | [ ] |
| (4) | Deployment to the field | [ ] |

11. (U) COOPERATIVE AGREEMENTS: The Tri-Service (Air Force led) Mark XV IFF program was the United States contribution to the NATO Identification System, Question and Answer Component (NIS Q+A) research and development efforts focused on interoperable identification capability within the NATO alliance. The United States cooperated with the other NATO nations (United Kingdom, France, Federal Republic of Germany, and Italy) and reached an agreement, in December 1986, on the basic operating characteristics (e.g., signals-in-space) of this future identification system. The five nations cooperated, through the exchange of technical information and limited interoperability testing necessary to reach a tentative waveform agreement in FY 1987. During FY 1986 and FY 1987, the United States Governement explored the opportunities for cooperative development during the full scale development phase of the US Mark XV IFF program. In addition to the funding within project 2598, the Mark XV IFF program received $17.0 million in FY 1986 ($8.5 million from 0603790F, $5.2 million from 0603790A, $3.3 million from 0603790N), and $2.5 million in FY 1987 (0603790N) as a designated Tri-Service NATO Cooperative RDT&E program. Contractors involved are the current Mark XV development and support contractors.

Budget Activity: 4. Tactical Programs
Program Element: 0604725F, Mark XV

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604725F, Mark XV

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604725F, Mark XV

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604725F, Mark XV

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604733F
DOD Mission Area: 224 - Defense Suppression

Title: Surface Defense Suppression
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 27,268 | 9,961 | 39,787 | TBD | TBD |
| 3006 | Standoff Attack GBU-15 $P^3I$ | 27,268 | 9,961 | 39,787 | TBD | TBD |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element (PE) develops and tests the improved data link which is an upgrade to the current GBU-15 data link to provide the GBU-15 an antijam data link to ensure total system performance in current and projected dense electronic countermeasures environments. This program element (PE) also develops and tests advanced support equipment to replace the current GBU-15 support equipment. The advanced support equipment will provide increased efficiency, reliability, and mobility compared to the old support equipment. Reliability will be increased by six fold (500 hours mean time between failures versus 80 hours for the old support equipment). Mobility is greatly increased with the advanced support equipment which is composed of two-man portable modules versus the older 875 pound single unit support equipment. This program element (PE) also develops and tests the AGM-130A air-to-ground weapon system. The AGM-130A is a Preplanned Product Improvement ($P^3I$) of the GBU-15 previously developed under this PE. While the lower cost GBU-15 is effective against targets protected by terminal defenses, the AGM-130 is designed to attack high value targets which have extended terminal area defenses. The AGM-130A is the only Air Force general purpose short range standoff attack weapon. It has a 2,000 pound warhead and the television (TV) or imaging infrared (IIR) seeker of the GBU-15 coupled with a rocket motor for extended range. It will use the improved data link and advanced support equipment being developed for the GBU-15. The AGM-130A will have the capability to attack from standoff range, well outside terminal area defenses, in day and night and in an electronic countermeasures environment. The AGM-130A will be certified for carriage and delivery from the F-4E and F-111F aircraft.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 27,550 | 40,775 | 28,137 | 6,053 | 372,491 |
| Missile Procurement (AGM-130A) | 15,683 | 44,761 | 93,865 | 1,423,917 | 1,592,500 |
| Other procurement (GBU-15) | 107,158 | 0 | 0 | 0 | N/A |
| Aircraft Procurement | 0 | 0 | 26,900 | 148,561 | 175,461 |

EXPLANATION: (U)

- RDT&E decreased in FY 1988 due to a $30.814 million cut in appropriations. RDT&E increased in FY 1989 by $11.650 million to continue the development effort delayed from FY 1988. Development efforts delayed from FY 1988 included development of the antijam improved data link and advanced support equipment for the inventory GBU-15 weapons and AGM-130 missile development.

- Missile procurement decreased in FY 1988 due to a $44.761 million cut in appropriations. FY 1989 missile procurement was deleted due to missile development problems. This was a $93.865 million reduction. If the missile works well in scheduled tests, it will compete for production funds in future Air Force budgets.

- Aircraft procurement was deleted in FY 1989 ($26.900 million reduction) because aircraft improved data link pod procurement was delayed by the cut in FY 1988 RDT&E appropriations.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement (PE 0207165F) | | | | | |
| Funds | 1,471 | 0 | 0 | 0 | 1,471 |
| Quantities (AGM-130A) | 0 | 0 | 0 | 0 | 0 |
| Other Procurement (PE 0208030F) | | | | | |
| Funds | 113,074 | 0 | 0 | TBD | TBD |
| Quantities (GBU-15) | 550 | 0 | 0 | TBD | TBD |

5. (U) RELATED ACTIVITIES: A Part Task Trainer (PTT) simulator for the GBU-15/AGM-130A is being developed under Program Element 0604227F, Flight Simulator Development.

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB MD and Armament Division (AD), Eglin AFB FL. Major contractors are Rockwell International (GBU-15 and AGM-130 prime contractor), Duluth GA and Hughes Aircraft Co. (current GBU-15 data link contractor), Culver City/Canoga Park CA and Hughes Georgia Inc (HGI), LaGrange GA (IIR seeker contractor). Harris/Magnavox team, Melbourne FL is the contractor for the improved data link. The contractor for the advanced support equipment program has not yet been identified.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3006, Standoff Attack GBU-15 Preplanned Product Improvement ($P^3I$)

A. (U) Project Description: Develops and tests an upgrade to the current GBU-15 data link to ensure total system performance in current and projected electronic countermeasure threat environments. Develops and tests advanced support equipment for the GBU-15 which will provide increased efficiency, reliability, and mobility compared to the old support equipment. Reliability will be increased by six fold (500 hours mean time between failures versus 80 hours for the old support equipment). Mobility is greatly increased with the advanced support equipment which is composed of two-man portable modules versus the older 875 pound single unit support equipment. This project also develops and tests the AGM-130A (a powered GBU-15). The guidance system for the AGM-130 will remain GBU-15's television (TV) and imaging infrared (IIR) seeker with a controlling data link. The AGM-130A utilizes a 2000 lb unitary warhead (MK-84).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Began full scale development of the improved data link. Continued AGM-130A DT&E. Completed motor qualification. Continued integration of the AGM-130 on the F-4E and F-111F.

(2) (U) FY 1988 Program: Continue improved data link full scale development and AGM-130A DT&E. Start AGM-130 IOT&E.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continue improved data link full scale development for the GBU-15. Initiate development of advanced support equipment for the GBU-15. Complete AGM-130A DT&E/IOT&E with the TV seeker. Analyze GBU-15 IIR seeker ability to support the AGM-130A mission.

(4) (U) Program to Completion: Complete development of the improved data link and advanced support equipment and initiate production. Complete development of the AGM-130 missile. If the missile works well in scheduled tests, it will compete for production funds in future Air Force budgets.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) AGM-130A FSD Start | | September 1984 |
| (2) (U) AGM-130A DT&E/IOT&E Start | | September 1985 |
| (3) (U) AGM-130A Critical Design Review Complete | | May 1986 |
| (4) (U) Improved Data Link FSD Start | | November 1986 |
| (5) (U) Advanced Support Equipment FSD Start | *(1st Quarter FY 1988) | 1st Quarter FY 1989 |
| (6) (U) Improved Data Link Low Rate Production Award | *(4th Quarter FY 1989) | 3rd Quarter FY 1990 |
| (7) (U) Advanced Support Equipment Procurement | *(4th Quarter FY 1990) | 1st Quarter FY 1992 |

* Date presented in FY 1988/89 Descriptive Summary.

(U) **Explanation of Milestone Changes**

(5) (U) FY 1988 Congressional budget cut delayed the FSD start.
(6) (U) FY 1988 Congressional budget cut delayed development and consequently the production start.
(7) (U) FY 1988 Congressional budget cut delayed the FSD start and consequently procurement.

9. (U) **COOPERATIVE AGREEMENTS:** Not Applicable.

Budget Activity: 4. Tactical Programs
Program Element: #0604733F, Surface Defense Suppression

AS OF: January 1988

**Test and Evaluation Data**

1. (U) Development Test and Evaluation (DT&E): The GBU-15 glide weapon consists of guidance, control and airfoil modules which are integrated with the MK-84 unitary warhead. Guidance is provided by either a television (TV) or imaging infrared (IIR) seeker with data link control. Thirty GBU-15/TV bombs were launched in DT&E with 27 hits. DT&E results were reported in the DT&E/IOT&E of GBU-15(V)/B Cruciform Wing Weapon and the AN/AXQ Data Link System report, March 1978, US Government distribution. Full rate production of the GBU-15 TV version was authorized in 1983.

(U) Five launches were conducted in the GBU-15/IIR DT&E program, all of which were off an F-4E aircraft. Three of the five launches were successful. Of the two misses, one weapon overflew the target as a result of an accumulation of events involving data link video breakup, tactics and seeker limitations. The second miss resulted from a weapon computer dump caused by aircraft power transients. This problem was corrected by initiating the weapon battery power earlier in the launch sequence. Thirty-five F-4E and two F-111F effective captive flights were flown in support of DT&E. DT&E results were reported in the DT&E of GBU-15 with Infrared Guidance Module report, May 1978, US Government distribution.

(U) The AGM-130 is a product improvement to the modular guided glide bomb, GBU-15. The AGM-130 consists of the basic GBU-15 with a propulsion system for increased standoff range and expanded mission capability. The AGM-130 Full Scale Development (FSD) program consists of developing an AGM-130/A with a MK-84 (2000 lb) unitary warhead. Because of the similarities with the GBU-15, the AGM-130 testing will be a combined Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E). The Air Force Operational Test and Evaluation Center (AFOTEC) will conduct the OT&E portion of the combined DT&E/IOT&E. AGM-130A DT&E conducted to date includes fit checks with the weapon on the F-4 and F-111 aircraft, captive training flights, captive compatibility flights, and seven successful Separation Test Vehicle jettisons. Simulations and captive flight tests of the AGM-130A TV seeker with different fields-of-view (FOV) have been accomplished and a six degree FOV was chosen for the AGM-130A TV seeker. Three (3) motor separation test vehicles (MSTVs) were dropped from the F-4E and achieved limited success in satisfying test objectives. One autopilot verification test vehicle (AVTV) was launched and a leak of gas used for fin control caused an immediate loss of control. Two guided test vehicles (GTVs - full up missiles) have been launched. The first GTV launch was guaranteed by the contractor and flew approximately 82 seconds of the planned 110 second flight before control was lost due to inadequate autopilot gain and phase margins. The contractor is replacing this vehicle. The second launch was completely successful and demonstrated the missile design now satisfies all the requirements reflected in the objectives for the MSTV, AVTV, and first GTV tests. AGM-130A DT&E flights officially began with the first successful (second) GTV launch. An additional seven GTV launches are planned for DT&E of the TV version of the AGM-130A.

(U) The development contractor for the GBU-15 and AGM-130 is Rockwell International Corp., Duluth GA. Program management is provided by Headquarters, Air Force Systems Command, Andrews Air Force Base MD, and its subordinate organization, Armament Division, Eglin Air Force Base FL.

Budget Activity: 4. Tactical Programs
Program Element: #0604733F, Surface Defense Supression

2. (U) Operational Test and Evaluation (OT&E): The GBU-15/TV Initial Operational Test and Evaluation (IOT&E) was conducted from February 1975 through February 1980 and results are reported in the Tactical Air Command (TAC) DT&E/IOT&E of GBU-15(V)/B Cruciform Wing Weapon, Phase I and II report, November 1978, US Government distribution, and the TAC IOT&E of GBU-15(V)/B Cruciform Wing Weapon, Phase III and IV report, May 1980, US Government distribution. The GBU-15/TV successfully completed Follow-on Operational Test and Evaluation (FOT&E) on 17 November 1983 with 16 direct hits out of 18 launches and full rate production was authorized. One hundred and eighteen F-4E and 106 F-111F effective sorties were flown in support of FOT&E. FOT&E results were reported in the FOT&E of GBU-15 TV/DL report, December 1984, US Government distribution.

(U) An opportunity to quickly and economically field a second version of the GBU-15 opened up when the AGM-65D imaging infrared (IIR) seeker became available. The IIR seeker provided a night and limited adverse weather capability. The purpose of the following IIR GBU-15 OT&E effort was to verify the integration of already-proven components, and to provide data on the proper TV/IIR weapon mix for GBU-15 operational use. The Air Force Operational Test and Evaluation Center (AFOTEC) conducted the Initial Operational Test and Evaluation (IOT&E) of the IIR GBU-15 from Jul 83 to Feb 85. Eleven IIR GBU-15s were released from the F-4 and F-111. Of seven "valid" launches, five were hits and two were misses due to weapon steering problems. Numerous problems with seeker integration and the autopilot were identified. Of the remaining four launches, one launch was a reliability failure. Problems on the remaining three launches could not be clearly attributed to any one cause. Compatibility and interoperability with current delivery systems was considered marginal. The array of weapon failure modes, coupled with the difficulties of learning to use a new and complex weapon system, made unambiguous interpretation of test results impossible. Overall operational effectiveness remained undetermined. Problems were also noted with the GJM-55 shop maintenance test set and technical data. Clearly, the IIR GBU-15 was not yet optimized for its operational mission. The decision was made to defer full rate production until further system modifications could be incorporated and to perform further operational testing.

(U) AFOTEC conducted IIR GBU-15 FOT&E (1) in two parts from Dec 86 to Jul 87. After three weapons were released, FOT&E (1) Part I was terminated when a manual tracking problem was confirmed. After this problem was corrected, FOT&E (1) Part II expended 19 weapons (a 20th weapon was withheld for later electro-optical countermeasures testing by the Office of the Test Director). There were 12 direct hits, three reliability failures, and four aircrew-induced failures (the weapon systems officer failed to identify the target). FOT&E (1) Part II concluded that the IIR GBU-15 was operationally effective, but the mission was very demanding. Weapon reliability (the only suitability area evaluated) was deficient primarily due to the control module and the weapon data link (which are operational on the TV version). Test set performance remained an open issue due to non-availability of an upgraded test set. Test set suitability was marginal. IIR GBU-15 FOT&E (1) results were reported in the AFOTEC GBU-15(V)2/B (GBU-15/IR) Modular Guided Bomb FOT&E, Phase I report, September 1987, US Government distribution.

(U) The Tactical Air Command (TAC) will conduct FOT&E Phase 2 using 20 IIR GBU-15s in FY 88 and will address deficiencies identified in previous operational testing.

Budget Activity: 4.Tactical Programs
Program Element: #0604733F, Surface Defense Suppression

(U) AGM-130 testing will be a combined Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E) with the Air Force Operational Test and Evaluation Center (AFOTEC) conducting the OT&E portion. Tests will be conducted at Eglin AFB using the ARN-101 F-4E aircraft and at McClellan AFB using the F-111F aircraft. China Lake Naval Weapons Center ranges will be used for the F-111F launches. A total of nine Guided Test Vehicle launches are planned for IOT&E of the TV version of the AGM-130A. The missions will be flown by Tactical Air Command (TAC) aircrews with TAC maintenance personnel maintaining the system. In addition, captive-carry missions will be flown in Europe by F-111F aircraft and crews from Lakenheath AB UK. The AGM-130A IOT&E was scheduled to start in March 1986. Due to development problems, the program has been delayed and is now scheduled to begin in June 1988. Approximately 10 months will be required to complete IOT&E. The Test and Evaluation Master Plan for the AGM-130A is in final coordination between OSD and the Air Force. Due to the problems with the data link control system encountered in the TV GBU-15 OT&E conducted by TAC, AFOTEC will not evaluate the data link during AGM-130A IOT&E. However, an improved data link (IDL) is presently under development and a separate OT&E will be conducted at a later date.

3. System Characteristics:

| Characteristics | Objective | Threshold | Demonstrated[1] |
|---|---|---|---|
| Maximum Mach | | | |
| Maximum Altitude (feet) | | | |
| Minimum Altitude (feet) | | | |
| Range (Nautical Mile) GBU-15 | | | |
| AGM-130 | | | |
| Accuracy (feet) (Circular Error Probable) | | | |
| Reliability (weapon hardware inflight) | .95 | .90[3] | .954 |

1 Demonstration of parameter maximum was not necessarily a test objective.
2 Data not specified in technical specifications.
3 Tactical Air Command goal for Initial Operational Test and Evaluation.
4 Demonstrated during Development Test & Evaluation/Initial Operational Test and Evaluation.
5 Demonstrated during Development Test and Evaluation program conducted by Air Force Systems Command.

Budget Activity: 4.Tactical Programs
Program Element: #0604733F, Surface Defense Suppression

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| GBU-15/IIR Follow-on Operational Test & Evaluation FOT&E(I) Complete | July 1987 | July 1987 | |
| AGM-130/A Development Test & Evaluation (DT&E) Start | September 1985 | September 1985 | Ongoing |
| AGM-130/A DT&E Launches Start | August 1987 | December 1987 | Contractor August 1987 launch failed. Government DT&E started with successful flight in December 1987 |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| GBU-15/IIR FOT&E(II) Start | April 1988 | |
| AGM-130/A IOT&E Start | June 1988 | Test start delayed from January 1988 due to development delays |
| AGM-130/A F-4E DT&E Launches Complete | 4th Qtr FY 1988 | |
| AGM-130/A F-111F DT&E Launches Start | 1st Qtr FY 1989 | |

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604740F    Title: Computer Resource Management Technolog
DOD Mission Area: 440 - Technical Integration/Studies and Analyses    Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 14,261 | 9,961 | 13,156 | Continuing | N/A |
| 2239 | Computer Security Tech | 1,580 | 1,300 | 1,202 | Continuing | N/A |
| 2522 | Requirements Analysis | 952 | 972 | 932 | Continuing | N/A |
| 2523 | Management Control Tech | 890 | 235 | 777 | Continuing | N/A |
| 2524 | Policy & Procedure Guidance | 1,000 | 770 | 1,164 | Continuing | N/A |
| 2526 | Software Engineering Tools & Methods | 920 | 705 | 753 | Continuing | N/A |
| 2983 | Logistics Info. Mgmt. Support Sys. (LIMSS) | 4,800 | 3,738 | 4,685 | Continuing | N/A |
| 3315 | Automation of Technical Information | 4,119 | 2,241 | 3,643 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is an engineering development program that addresses problems of acquiring computer resources embedded in Air Force systems. This PE is a primary vehicle for transferring the products of advanced development efforts in computer resource technology into system applications. The objectives are to identify, develop and transfer into active use, tools, techniques and computer technology advances that support the following: (1) Providing reliable, survivable and secure systems, (2) Reducing software development and support costs, (3) Providing timely development and support of computer resource products, (4) Enhancing in house productivity and the ability to acquire and support systems, (5) Providing a totally integrated capability to create, accept, retrieve and store digital (paperless) technical information for life cycle support for Air Force Logistics Information Systems. Excludes civilian and military manpower and their related costs and military construction costs which are included in appropriate management and support elements in this program.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 10,633 | 20,367 | 21,667 | Continuing | N/A |

EXPLANATION: (U) - The FY 1988 decrease is due to Congressional reduction. The FY 1989 decrease reflects the restructuring of this Program Element due to Air Force priorities.

4. (U) **OTHER APPROPRIATION FUNDS:** Not Applicable.

5. (U) **RELATED ACTIVITES:** This Program Element (PE) is coordinated with the consolidated DOD Software Initiative (PE 0603756D) which includes the DOD ADA Joint Program, the Software Technology for Adaptable and Reliable Systems (STARS) Program. It relates to PE 0603728F, Advanced Computer Technology, PE 0207595F, Base Communications-Tactical Air Forces and PE 0603106F, Logistics Systems Technology. The Joint Logistics Commanders effort is supported through this program. Air Force technology efforts and initiatives generally transition to this PE from PE 0603728F and are coordinated through technical reviews at staff and engineering levels. Inter-Service coordination is done through the DOD Computer Security Center, the SEI, STARS, and OSD program management reviews.

6. (U) **WORK PERFORMED BY:** The Electronic Systems Division (ESD), Hanscom AFB MA, has management responsibilities for the program except for Project 3315 and support of the JLC which are managed by the Deputy Chief of Staff for Product Assurance and Acquisition Logistics, Headquarters, Air Force Systems Command (AFSC), Andrews AFB MD. Seven AFSC organizations are actively participating in tasks funded under this PE. Contractors include the MITRE Corporation (all projects), Bedford, MA; Hughes Aircraft Co. (Project 2522), Fullerton, CA; Dynamics Research Corporation (Projects 2523, 2524), Wilmington, MA; Aerospace (Projects 2239, 2239, 2522, 2524, and 2526), Los Angeles, CA; Logicon (Project 2523), San Pedro, CA; Advanced Technology Corporation (Project 2523), Reston, VA; Softech (Project 2526), Waltham, MA; Support Systems Associates (Project 2239), Lexington, MA; Intermetrics Incorporated (Project 2526), Cambridge, MA; Dynatrend Incorporated (Project 3315), Cambridge, MA; Computer Development Corporation (Project 3315) Cambridge, MA; Transportation Systems Center (Project 3315), Cambridge, MA; and CACI (Project 3315), Arlington, VA.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:**

A. (U) Project: 2239, Computer Security Technology. Develop technologies, techniques, and validation procedures for use in Air Force/DOD systems in response to the DOD Computer Security Initiative 5215.1. This project concentrates on demonstration and transition of "trusted" (i.e. security proven) systems and security mechanisms; enhancement and support of computer security verification/validation procedures; and computer security support to the acquisition of Air Force systems and to the Air Force Computer Security Program Office. In FY 1987 this project: completed Computer Security R&D briefings; completed the Computer Security Test and Evaluation Guide for use by all Air Force installations; continued development of a Multi-Level Secure Database Management System; began development on the Secure Communication Link; continued requirements definition needed to meet the Computer Security requirements of the Strategic Air Command's (SAC) Statement of Need (SON) 10-82; completed the Advanced User Authentication report on Biometric technology; completed the Computer Security Products Technology overview; continued work on a trusted local area network; and began contract preparations for the Multi-Level Database Design Tool (MDDT). In FY 1988 this project will continue contract preparation for the Multi-Level Secure DBMS; complete the study for the TCSEC Specification and Verification Documentation Applicability Report (includes computer security Data Item Descriptions for DOD STD 2167); continue work on SAC's SON 10-82. In FY 1989 this project will continue development of the Multi-Level Secure DBMS; begin development of the MDDT; and continue computer security work on meeting SAC SON 10-82 requirements.

B. (U) Project: 2522, Requirements Analysis. Develop and apply tools that provide Air Force program offices

with rapid insight into the technical performance, cost, schedule, and high risk implications of stated computer resources system requirements. These tools structure and control changing requirements; explore performance and supportability trade-offs; and examine alternatives prior to making hardware, software, and financial commitments. This project also assists users in their initial application of these requirements analysis and tracking tools. In FY 1987, the project began the development of a Display Rapid Prototyping and Simulation System (DRPS), continued shakedown and initial application of the Database Design Evaluation Workbench (DDEW); and completed enhancements to the Automated Interactive Simulation Modeling System (AISIM). In FY 1988 the project will continue development of the DRPS; distribute the enhanced AISIM software; and evaluate using the DDEW as the basis of the Multi-Level Database Design Tool. In FY 1989 the project will continue development of the DRPS; and begin rehosting the Technical and Managerial Support Environment/Document Writer system from its existing base to a more readily available Air Force standard small computer system.

C. (U) Project: 2523, Management Control Technology. Develop and evaluate methods for estimating software development costs and defining acquisition strategies and practices that aid in the control of mission-critical computer resources. Efforts will support the Joint Logistics Commanders (JLC) objectives to eliminate unnecessary duplication and proliferation of software acquisition standards and practices among the three Services. In FY 1987, the project provided support to the JLC; delivered the Ada/Jovial Tool Catalog; continued development of the Mission Critical Computer Resource (MCCR) Standardization Plan; completed prototype development of the Automated System Design Library (ASDL), an automated tool for use in software cost estimating. In FY 1988 the project will transition the JLC support to Project 2524; complete the transition of the Ada/Jovial Tool Catalog to Warner Robbins AFB; continue the development of the ASDL; begin development of the Quality Management Tool (QMT) with the Rome Air Development Center. In FY 1989 this project will continue development of the ASDL and the QMT; begin development of Space Division's Software Metrics, Manager's Decision Aid, and Avionics Reliability Design Assessment.

D. (U) Project: 2524, Policy and Procedure Guidance. Develop comprehensive guidance on policies and procedures that lead to improvements in the planning, acquisition, and support of mission critical computer resources. Through the use of guidebooks, video tapes, multimedia training methods, and automated management aids, this project will provide training to Air Force personnel in software acquisition management. In FY 1987, this project completed the critical software prototyping protocol, Space Division's MIL-Prime documentation and the Computer Based Instruction applications task; initiated work on the Test Plans/Procedures, the Software Product Specification Evaluation Criteria, and the Mission Critical Computer Resource (MCCR) Acquisition Library System (MALS). Work on the rehosting of the Instructional Support System and Reinforcement of the Computer Resources Acquisition Course (CRAC) was also started. Work on these two projects and MALS will continue through FY 1988. In FY 1989 MALS and the rehosting of the CRAC will finish. The rehosting of the Instructional Support System will continue and work on the Computer Based Training Software Standardization Initiative and Reusability Training Videotape projects will begin.

E. (U) Project: 2526, Software Engineering Tools and Methods. Develop and implement a comprehensive set of integrated tools to improve the software development, acquisition, and support (e.g., maintenance) processes. In addition, this project will place major emphasis on providing planning and support for the introduction of the Ada High Order Language (HOL) into the Air Force and the introduction of Artificial Intelligence to improve engineering

approaches to software development. In FY 1987: development of the Program Manager Guide Supplement and the Expert Missile Maintenance Aid (EMMA) was continued. Definition of the Ada Production Quality Compiler was completed and a study of applications of the Natural Language Processing for Secure Database Interaction was begun. In FY 1988 the project will continue development of the Natural Language Database Interface and explore technical feasibility of applying a Neural-Computer to aid in software development. In FY 1989 EMMA will be completed; the Natural Language intelligent database search and retrieval system will be installed and tested; Ada's applicability to tactical missile software applications will be tested; a guide for the use of an integrated Ada programming environment will be published and improvements in programmer productivity through off-the-shelf software engineering tools will be examined.

F. (U) Project: 2983, Logistics Information Management Support System (LIMSS). This is a long term development effort to provide a standard architecture and a Communications, Command and Control ($C^3$) infrastructure that will network various logistics information systems. This will improve wartime capability by improving information access, timeliness, and accuracy. The program will provide a broad plan to integrate the various logistics information systems being developed autonomously. Program responsibilities include overall planning, coordination, systems engineering, integration, test, and implementation. In FY 1987: the LIMSS program completed an Air Force-wide logistics information system architecture and implementation plan for developing and fielding new information systems. The LIMSS program office established liaison with the Computer Aided Logistics Support (CALS) program to ensure incorporation of CALS objectives in this architecture. Through the LIMSS interface control working group, the first segment of an integrated network of systems was designed and tested. Work on a seamless logistics information system environment was continued. In FY 1988 the project will: complete an assessment of the logistics information activities and their relationship to the logistic ADP goals established in the Logistic and Engineering ADP Plan. The first draft of the Logistics Communication-Computer System (C-CS) Plan will be completed. This Plan will be used to guide the evolution of new information systems and improvements to existing systems. This project will continue to maintain the logistics information systems and initiatives database. In FY 1989 the project will expand the C-CS Plan. Subject area data bases will be defined; physical connectivity to the Defense Data Network and Local Area Nets will be achieved. The logistics information systems architecture will be updated.

G. (U) Project: 3315, Automation of Technical Information (ATI). DOD Defense Guidance and Office of the Secretary of Defense (OSD) funding initiatives have emphasized the need to improve the preparation, delivery, use and updating of technical information used in the design, manufacture, maintenance and operation of DOD weapon systems. Currently, a variety of initiatives are underway to automate technical information and logistics support data. In FY 1987 the Management Integration Office (MIO) completed a Program Management Plan and pursued implementation of Computer Aided Logistic Support (CALS) projects on current and planned weapon systems. Research was begun on developing modular Technical Order (TO) and Logistic Support Analysis (LSA) plans. These plans are geared to the architecture and infrastructure required to use digital information in the creation and use of TOs and LSA data. This work will continue throughout FY 1988 and FY 1989 in order to exploit highly-promising extension of prior-year efforts.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

**Program Element:** 0604750F
**DOD Mission Area:** #327 - TIARA for Tactical Air Warfare

**Title:** Intelligence Equipment
**Budget Activity:** #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 12,162 | 5,905 | 4,875 | Continuing | N/A |
| 1174 | Intelligence Security Equipment | 1,002 | 844 | 921 | Continuing | N/A |
| 1955 | Air Force Indications & Warning | 8,772 | 2,946 | 1,517 | 0 | 20,570* |
| 2053 | Foreign Technology Division Intelligence Processes | 2,388 | 2,115 | 2,437 | Continuing | N/A |

*Funds to continue support for the Air Force Indications and Warning project were deleted starting in FY 1990; this value represents the project total for FY 1986 through FY 1989.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element supports USAF operating commands by performing the engineering development of ground equipment and/or techniques used to process, integrate, display and distribute intelligence data. This equipment will reduce the time required for the exploitation of intelligence data to meet the needs of Air Force agencies producing strategic, tactical, and scientific and technical intelligence. Equipment and techniques are also developed to counter the foreign intelligence threat to the USAF mission. In those cases where contractor estimates exist, this program is budgeted at the most likely cost and does not differ materially from known contractor estimates.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 10,070 | 5,928 | 4,880 | Continuing | N/A |

EXPLANATION: (U) Funds were added to all three projects in this PE to fulfill outstanding requirements in FY 1987. In Project 1955, $750 thousand paid for increases in the general, administrative and overhead rates of an ongoing contract; $530 thousand was required to settle a contract dispute arising from an architecture change. In Project 2053, $300 thousand was required to purchase a replacement computer for a task in which the previously selected computer became unsupportable. In Project 1174, $150 thousand was required to correct software deficiencies in a prior year project. The balance of funds were used to pay for software developments in different segments of the Air Force Indications and Warning project.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. RELATED ACTIVITIES: Operation and maintenance (O&M) as well as procurement funds for equipment developed in the Intelligence Security Equipment project are in PEs 0305127F (Foreign Counterintelligence) and 0305128F (Security and Investigative Activities). The R&D efforts in this project are coordinated with the This prevents duplication of effort and promotes an exchange of capabilities among its members. The indications and warning project receives O&M and procurement funds from PEs 0301328F (Strategic Air Command), 0301334F (Air Force Other Commands) and 0301335F (Air Force Automated Data Processing Support). The RDT&E funding from this program as well as funds from the PEs mentioned above are combined together into a single integrated effort which is managed by the Rome Air Development Center, Griffiss AFB, NY. The Intelligence Processes project at Foreign Technology Division develops software, equipment and analysis methods which are supported in PE 0301310F (Foreign Technology Division).

6. (U) WORK PERFORMED BY: Major contractors are International Computing Company (Projects 1955, 2053), McLean, VA; Planning Research Corporation (Project 1955), McLean, VA; Rockwell International (Project 2053), Canoga Park, CA; Sterling Corporation (Project 1955) Bellevue, NE; and Unisys Corporation (Project 1174) Salt Lake City, UT. In addition, there are 11 other contractors with a total current contract value of $5,380 thousand.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. Project: 1174, Intelligence Security Equipment. This project develops sophisticated equipment

The program, called Technical Surveillance Countermeasures, is the only Air Force program developing equipment to support this type of counterespionage. The state-of-the-art in electronics and covert communications devices is constantly changing and becoming more sophisticated each day. The AFOSI needs this research and development program and to protect the Air Force investment in advanced technology. Several independent tasks are conducted simultaneously; as tasks are completed, others are initiated to satisfy outstanding, validated requirements. During FY 1987, the project continued development of an This new device will eliminate

Another ongoing effort is to develop a This device will In FY 1988 this project will complete development of an At this time the device will be evaluated and a production decision will be made as to whether or not to incorporate the device into AFOSI operations. In FY 1989 the project will complete the In addition, an effort to develop a will be initiated. The practicality of this latter project had been evaluated in an earlier study, however, limited funding prevented further work in this area. Cost estimates for this project are Category II, Mature.

B. Project: 1955, Air Force Indications and Warning (I&W). This project provides support to the Strategic Air Command and Military Airlift Command Intelligence Centers to develop techniques and capabilities to provide I&W support to operational Air Force assets. These centers are part of a coordinated Department of Defense I&W system

[

This project will improve the current I&W system by making advances in data handling, message processing, data correlation/fusion techniques and decision aids. During FY 1987 at Strategic Air Command (SAC), facility modifications and installation of equipment were started. The system software design was completed and coding of individual segments was initiated. In FY 1988 formal test, acceptance and cutover will occur. This development will provide SAC with a[

] It will serve as the foundation from which a comprehensive I&W system could be developed. There are no funds available in FY 1989 to continue this effort to its fruition. During FY 1987 at Military Airlift Command (MAC) the final acceptance and turnover of an automated I&W capability to support military airlift was completed. The system includes a comprehensive terrorist data base, and provides data for route planning, threat assessments, and landing and extraction zone analysis for rescue. Also in FY 1987 a new effort to extend this I&W capability at the headquarters to 21 different operational sites worldwide was initiated. When completed in FY 1989 all of the data base information and intelligence analysis capabilities available at the headquarters will be locally available at MAC detachments to provide more timely information to aircrews. In addition the system will provide Special Operations Forces with[

] In FY 1988 site surveys and technical requirement specification will continue for the various operational locations that will receive this capability. During FY 1989 the system will undergo testing, acceptance and transition into an operational system. Cost estimates for this project are Category II, Mature.

C. Project: 2053, Foreign Technology Division (FTD) Intelligence Processes. FTD's mission is to acquire evaluate, analyze and report on foreign scientific and technological progress in response to Department of Defense/Defense Intelligence Agency tasking. Current FTD[

] The advent of[

] This project improves the FTD capability to acquire, evaluate, analyze, and report on foreign scientific and technical information and material. These improvements will assist in responding to intelligence requirements vital to operational commanders, research and development planners, and national level agencies. It will develop new capabilities to provide timely and accurate threat assessments of foreign weapon system technology. Analyst oriented techniques will support analysis of[

] Database management techniques and text and sensor data processing capabilities pertinent to FTD's mission will also be addressed. Numerous independent tasks are conducted simultaneously. As tasks are completed, new tasks are initiated to satisfy outstanding, validated requirements. Accomplishments during FY 1987 include software developments to[

] Also a program to develop an[

] A test bed to[

] was finished. An expert system to aid in the analysis of[

] were also finished. During FY 1988 new multi-year efforts will include a[

] Also a study to define[

] will be started. Efforts beginning in FY 1989 will include software to evaluate an[

Also, an artificial intelligence implementation of a model to predict the performance of . In addition two new efforts to evaluate Cost estimates for this project are Category II, Mature.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604754F
DOD Mission Area: 343 - Theater Communications

Title: Joint Tactical Information Distribution System (JTIDS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0* | 21,914 | 64,710 | Continuing | N/A |

* NOTE: Funding for FY 1987 was contained in OSD PE 0604771D.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop a highly jam resistant, secure digital information distribution system for use in a tactical combat environment. The Joint Tactical Information Distribution System (JTIDS) is a joint Army, Navy, Air Force and Marine Corps development employing time division, multiple access, and spread spectrum techniques. The system will provide the connectivity and capacity to permit rapid and secure exchange of the essential command, control, and status information among all equipped aircraft, ships and ground elements in the tactical theater. The Air Force is the lead service for development of JTIDS terminal equipment. The Air Force is also leading a concept definition effort with eight NATO nations for a low volume JTIDS terminal for future fighter applications.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 0* | 44,072 | 64,772 | Continuing | N/A |
| Aircraft Procurement | | | | | |
| E-3 Class I Terminal Modification (PE 0207417F) | 0 | 0 | 0 | N/A | 79,500 |
| E-3 Class 2/ TADIL-J Modification (PE 0207417F) | 0 | 0 | 0 | 138,246 | 138,246 |
| F-15 JTIDS Modification (PE 0207130F) | 25,800 | 58,000 | 59,500 | 0 | 143,300 |
| Other Procurement | | | | | |
| Ground Terminals (PE 0207434F) | 0 | 0 | 0 | 0 | 91,862 |

EXPLANATION: RDT&E - In FY 88, the JTIDS terminal integration funding was reduced by Congress by $22.1 million citing low terminal reliability during system testing. Procurement - Program delays awaiting reliability improvements resulted in a Congressional recession of $25.8 milion in FY 87 and a reduction of $43.8 million in the FY 88 F-15

procurement funding. For the same reason, the Air Force reduced FY 89 F-15 procurement funding by $11.5 million while rephasing the production schedule.

4. (U) OTHER APPROPRIATIONS FUNDS ($ in thousands):

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| F-15 JTIDS Modification (PE 0207130F) | | | | | |
| Funds[1] | 0 | 14,200 | 48,000 | 81,100 | 143,3000 |
| Quantities | 0 | 0 | 36 | 124 | 160[2] |

1 Funding is for aircraft kits. Does not include initial modification spares or communications security equipment for the F-15 modification kits.

2 Nine additional kits for flight simulators/maintenance trainers are not included in the funding figures.

5. (U) RELATED ACTIVITIES: The JTIDS development is managed by a jointly manned program office. This program element funds Air Force unique aspects of development, prototype fabrication, integration and test of the JTIDS terminal equipment as well as the total funding for the US portion of the NATO Multifunctional Information Distribution System (MIDS). The basic JTIDS Class 2 terminal development is funded under OSD PE 0604771D. Related Army and Navy program elements are PE 0604702A and PE 0604232N respectively.

6. (U) WORK PERFORMED BY: The Joint Program Office is located at the Electronic Systems Division, Hanscom AFB, MA. Work is also being done at the Aeronautical Systems Division, Wright-Patterson AFB, OH; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD.. The major contractors are Hughes Aircraft Company (Class 1 terminals), Fullerton, CA; Singer-Kearfott (Class 2 terminal full scale development (FSD), Little Falls, NJ; International Business Machines (surface terminal facility), Owego, NY; McDonnell Douglas Aircraft Corporation (Class 2 terminal integration into the F-15), St Louis, MO; and MITRE Corporation (system engineering support), Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: PE 0604754F, Joint Tactical Information Distribution System (JTIDS)

A. (U) Project Description: Currently, information upon which to base critical tactical operational decisions normally exists somewhere within a combat area, but may not always be available to the force element needing the data.

Consequently, there is an urgent requirement for a system that will distribute essential information to all participating elements. The system must provide for a high volume of message traffic, work in a severe jamming environment, and prevent hostile forces from intercepting and using the transmitted information. The JTIDS satisfies these requirements. The system will be structured to operate as an information distribution network into which tactical users transmit command and control, surveillance, position and status, or other significant combat information at specific time intervals. All of this information is immediately available to each net participant who may select for either display or data base storage that portion of the information in which he/she is interested. The system will interconnect the E-3 aircraft, ground, and shipboard command, control and surveillance centers with combat and support aircraft. Beginning inFY 1988, funds are provided for the development of a follow-on JTIDS Class 2 compatible terminal called the Multifunctional Information Distribution System (MIDS). This new program is an OSD directed, NATO cooperative development effort to design, fabricate, test and evaluate an advanced terminal for space constrained US and NATO fighter aircraft such as the USAF F-16. This program will extend the JTIDS capability throughout the tactical forces for both the US and NATO.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: A reliability growth plan to improve unsatisfactory terminal reliability problems was implemented. The initial reliability verification test showed a substantial increase in mean time between failure (MTBF). Studies and analysis by both the Air Force and Navy indicate that the design will support the desired MTBF. Developmental test with results showing that the equipment met all specifications with the exception of reliability was completed . Initial operational test and evaluation with results showing that the terminal on the F-15 enhanced mission effectiveness and pilot situational awareness was also completed . Operational effectiveness of the JTIDS terminal in the F-15 was rated satisfactory. Terminal reliability was confirmed as unsatisfactory.

(2) (U) FY 1988 Program: System integration and software development for the F-15 and MCE will continue. Full scale development of a follow-on low volume Class 2 compatible terminal will begin. This development is the NATO cooperative effort for the Multifunctional Information Distribution System (MIDS) which will be integrated into both US and NATO fighter aircraft. Funding for this effort will be shared by participating countries with the US taking the lead in development.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The reliability growth program will be completed and reliability verification testing will be conducted to confirm the MTBF prior to production contract initiation. F-15 integration efforts and software development will continue. Preproduction developmental design activities will be concluded. Transition to production for the Class 2 and the Class 2H high power terminal will occur. Design and development of peculiar support equipment will continue. Software development and integration efforts for MIDS will begin.

(4) (U) Program to Completion: This is a continuing program. Funds are provided for the integration of the JTIDS Class 2 terminal into the F-15 in 1991, into the JOINT STARS aircraft in 1992 and into the Modular Control

Equipment in 1993. The US share of the FSD funding for the MIDS Class 2 low volume terminal planned for production entry in the mid-to-late 1990's is also provided under this program element.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Waveform decision | | February 1976 |
| (2) | (U) | Initial E-3 Prototype Terminal Delivery | | June 1977 |
| (3) | (U) | Start Surface Terminal Development | | June 1977 |
| (4) | (U) | Start E-3 (Class 1) Terminal Low-rate Initial Production | | July 1980 |
| (5) | (U) | Start Fighter Terminal (Class 2) Full Scale Development | | January 1981 |
| (6) | (U) | Surface Terminal Long-lead Production Decision | | December 1981 |
| (7) | (U) | First Production Delivery of Class 1 (E-3) Terminal | | June 1982 |
| (8) | (U) | First Surface Terminal Production Delivery | | September 1984 |
| (9) | (U) | Development Test/Initial Operational Test and Evaluation (IOT&E) of F-15 Class 2 Terminal Complete | *(March 1987) | April 1987 |
| (10) | (U) | Class 2 Terminal Production Decision | *(June 1987) | May 1989 |
| (11) | (U) | First Class 2 Production Terminal Delivery | *(June 1989) | July 1991 |

*Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Changes:

(9) (U) Completion of IOT&E was delayed due to technical problems and the complexity of preparing and conducting a multiservice investigative assessment of the JTIDS system components.

(10) and (11) (U) The Low-Rate-Initial-Production decision for the Class 2 JTIDS terminal for the F-15 was delayed because of immature hardware reliability. A reliability growth plan is being executed and significant progress has been made toward meeting the reliability threshold for the production decision. The first terminal delivery will be two years after contract award.

9. (U) COOPERATIVE AGREEMENTS: The Office of the Secretary of Defense is sponsoring, under the Nunn Amendment legislation, the Multifuctional Information Distribution System (MIDS) NATO cooperative development project. This project is expected to enter full scale development during the second quarter of FY 89. Participants will include UK, Germany, Italy, France, Norway, Canada and Spain. This codevelopment program calls for the development of a smaller, low cost, Class 2 compatible terminal that can be produced to the maximum extent practical by the participating nations. The MIDS terminal cooperative development program will be structured in two phases. Phase I is a project definition phase with scheduled completion in FY 88. Phase II will be full scale development and will last approximately four years. Singer's Electronics Systems Division is the lead contractor for Phase I. Phase II contractors are to be determined.

Program Element: 0604754F Title: Joint Tactical Information Distribution System (JTIDS)
DOD Mission Area: 343 - Theater Communications Budget Activity: 4 - Tactical Programs

Financial commitments of the participating nations is set at a minimum of $500,000 each for the Phase I and equitable cost sharing for Phase II. Additionally, the US and UK entered into an agreement in September 1983, for the UK's development and acquisition of JTIDS equipment. The US and UK have a common requirement for an interoperable system, and a common objective to encourage the acceptance of JTIDS within NATO in the interest of NATO wide interoperability. The UK has based its JTIDS Full Scale Development Program on the US Class 2 Time Division Multiple Access terminal planned for incorporation into US F-15 aircraft. The agreement covers bilateral understandings associated with this equipment and technology. The UK Class 2 development is intended for the Tornado as well as UK.E-3 aircraft and is nearing completion. Negotiations are ongoing for cooperative production. France is also procuring JTIDS Class 2H terminals for its E-3 aircraft. The French JTIDS buy is dependent upon the successful US development and integration efforts for the Class 2 terminal.

Budget Activity: 4. Tactical Programs
Program Element: 0604754F, Joint Tactical Information Distribution System (JTIDS)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604754F, Joint Tactical Information Distribution System (JTIDS)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604754F, Joint Tactical Information Distribution System (JTIDS)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604754F, Joint Tactical Information Distribution System (JTIDS)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

**Budget Activity:** 4. Tactical Programs
**Program Element:** 0604754F, Joint Tactical Information Distribution System (JTIDS)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

Budget Activity: 4. Tactical Programs
Program Element: 0604754F, Joint Tactical Information Distribution System (JTIDS)

TEST AND EVAULATION DATA SHEET TO BE PROVIDED LATER.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: #0604756F
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Side Looking Airborne Radar (SLAR)
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 21,904 | 0 | 3,650 | Continuing | N/A |
| 2037 | SLAR Sensors | 5,885 | 0 | 3,650 | Continuing | N/A |
| 2451 | SLAR Exploitation | 16,019 | 0 | 0 | Complete | 124,154 |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops advanced high resolution SLAR components and systems capable of collecting radar imagery of ground targets from an airborne platform, followed by transmission, processing, and exploitation of the processed imagery to yield reconnaissance and strike information during day or night, and adverse weather conditions. Near-real-time SLAR imagery exploitation is performed in a ground station to achieve high resolution detection and to provide for of the radar sensor. The platform and ground stations are procured in PE 0207215F. Imagery-derived fixed target location reports are then sent to theater users including battlefield command centers, intelligence centers such as the Combat Operations Intelligence Centers in Germany and Korea, and strike systems such as the Joint Surveillance Target Attack Radar System (Joint STARS).

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 18,726 | 11,117 | 5,254 | Continuing | N/A |
| Aircraft Procurement (PE 0207215F) | 27,000 | 0 | 4,600 | 3,500 | 63,600 |
| Other Procurement (PE 0207215F) | 1,691 | 7,361 | 11,234 | 76,395 | 110,360 |

EXPLANATION: (U) The FY 1987 RDT&E increase resulted from required internal Air Force reprogramming actions for necessary computer security upgrades in the Tactical Reconnaissance Exploitation Demonstration (TREDS). In FY 1988, SLAR (RDT&E line 161) was inadvertently zeroed by the Appropriation Conference Committee. In a 3 February 1988 letter to the Secretary of the Air Force, the respective chairman of the House and Senate Appropriations Committees stated that it was the intent of Congress to approve the $11.117M request. The Office of the OSD Comptroller has ruled that the letter constitutes Congressional authority for "above threshold" reprogramming of up to $11.117M into the SLAR PE. Therefore, funding in this line will be restored to $11.117M by internal Air Force reprogramming action. The decrease in FY 1989 resulted from required internal Air Force reductions.

Program Element: #0604756F
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Side Looking Airborne Radar (SLAR)
Budget Activity: #4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement (ASARS-II) PE 0207215F: * | 27,000 | 0 | 4,600 | 3,500 | 63,600 |
| Other Procurement/Ground Station (PE 0207215F) | | | | | |
| Funds | 1,691 | 7,361 | 11,234 | 76,395 | 110,360 |
| Quantities ** | | | | 1 | |
| Military Construction: | | | | | |
| Funds | 8,930 | 0 | 8,500 | 22,338 | 58,143 |

* In FY 1989, aircraft procurement buys the depot level maintenance necessary to support production radar repair. This will reduce support costs, decrease repair time, and increase operational radar availability.

** FY 1988 funds procure support equipment for the first TR-1 ground station radar processor procured in FY 1985, plus changes to government funded equipment to permit installation in a fixed ground station instead of a transportable facility.

5. (U) RELATED ACTIVITIES: PE 0603208F, Advanced Electronics for Aerospace Vehicles, is performing advanced development efforts in foliage penetration radar techniques. PE 0603260F, Intelligence Advanced Development, is developing advanced techniques for managing tactical reconnaissance information. Exploited Side Looking Airborne Radar (SLAR) data will be an input to this system. PE 0207215F, TR-1 Squadrons procures operational Advanced Synthetic Aperture Radar System (ASARS-2) SLAR sensors and ground stations, and beginning with FY 1987, assumed development responsibility for common mission support elements in the TR-1 ground station. PE 0207217F, Tactical Air Reconnaissance System, is fielding an electro-optical system to upgrade the RF-4C and plans to incorporate a radar system or a day/night and adverse weather imaging capability in late 1990's.

6. (U) WORK PERFORMED BY: This program is managed by the Tactical Reconnaissance System Program Office, Aeronautical Systems Division, Wright-Patterson AFB, OH. Contractors: Hughes Aircraft Company, Culver City, CA, develops the ASARS-2 and ASARS-2 Processing Segment; Ford Aerospace, Palo Alto, CA, developed the prototype Tactical Reconnaissance Exploitation Demonstration System and is the prime contractor for the production TR-1 Ground Station.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

Project: 2037, SLAR Sensors

Program Element: #0604756F — Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: #327 - TIARA for Tactical Air Warfare — Budget Activity: #4 - Tactical Programs

A. Project Description: This project develops improvements for the Advanced Synthetic Aperture Radar System (ASARS-2), the ASARS-2 Processing Segment (APS), and Electronically Steered Antenna (ESA). With the completion of the Tactical Reconnaissance Exploitation Demonstration System (TREDS), Project 2451, SLAR Exploitation, was closed out for FY 1988 and beyond. The ASARS-2 exploitation system, which is part of TREDS, remedies the lack of a near-real-time image exploitation capability in current operational SLAR systems. The remaining small RDT&E tasks have been combined for reporting purposes. The development of the ASARS-2 Processing Segment (APS) is this project's highest priority. This effort develops and tests SLAR processing software and systems associated with the TR-1 Ground Station (TRIGS). Operational requirements include near-real-time processing and exploitation to achieve reliable detection, location, of fixed or mobile tactical sized targets (surface-to-air missiles, trucks, tanks, etc.) over a wide area. To meet these requirements, advanced digital exploitation techniques are used to enable trained radar image interpreters to identify and exploit targets on a display screen. The radar system provides a unique capability to penetrate cloud and other adverse atmospheric conditions in daylight or at night, operates at ranges beyond defensive threats, and provides accurate location and other intelligence about targets under conditions in which non-radar sensors are ineffective. The sensor has a search mode which produces up to a ; and two spot modes which produce a The ESA antenna will scan up to of radar modes and/or search areas.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The first ASARS-2 production radar entered flight test in June 1987 and was accepted in November. TREDS achieved limited operational capability in 1987 and greatly improves intelligence collection in central Europe. TREDS is the engineering prototype for TRIGS. TRIGS preliminary design review (PDR) was held in May 1987. Lessons learned from the operation and testing of TREDS were incorporated into the PDR. The development and test of TRIGS operational software will also benefit from TREDS operation. Software packages were written in FY 1987 in preparation for FY 1988 insertion into the ASARS-2 Processing Segment (APS) as it is being built and tested.

(2) FY 1988 Program: In FY 1988, a series of TRIGS critical design reviews are scheduled. Site preparation activities will also begin. Software development for the APS will continue. Development of an immediate spot mode will be pursued and tempest security improvements will be incorporated into the APS. Planning for system level testing will continue and testing of individual TRIGS elements and supplements will begin. Logistics development will continue with support equipment software writing. New production microcircuits will be integrated into the production APS. Work will begin to implement software and hardware changes necessary to extend the range of the search mode from the current or more.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, the APS is delivered to the TRIGS program. System level integration will begin at the contractor's plant, bringing together the APS, the radar imagery exploitation segment, the mission control segment, and the communications and support segments. Initial cadre

training will begin. An effort to achieve imagery yield at extended ranges equal to that which was specified at the original maximum range of will also be implemented. The funding levels are Category III budgetary estimates. In FY 1990, an effort to design and implement will also be initiated. A series of flight tests are planned in conjunction with this effort.

and is the final element in establishing a full operational capability in Europe for the TR-1 Tactical Reconnaissance System. A study will be initiated in FY 1991 to assess the design of a podded SLAR to be employed on a tactical reconnaissance aircraft which will lead to flight demonstration in the mid-1990's.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: #4, Tactical Programs
Program Element: #0604756F, Side Looking Airborne Radar (SLAR)

As of: 22 Feb 1988

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The SLAR system development is based upon a building block approach to providing a Tactical Reconnaissance System. The TR-1 Reconnaissance System (TRS) acquisition is a follow-on to the U-2R. Test and evaluation plans and reports of completed evaluations are documented in special access programs and will be made available to appropriately cleared personnel. Tests on the Advanced Synthetic Aperture Radar System (ASARS-2) sensor began in fiscal year 1981. Tests on the ground processing and exploitation station were completed in first quarter fiscal year 1986.

(U) The ASARS-2 development effort consists of two projects managed by the Aeronautical Systems Division. These projects are with the Hughes Aircraft Corporation for development of an airborne sensor and a radar ground processor. Multiple program requirements are being addressed in these projects to meet the need for national and tactical SLAR collection, processing, timely exploitation and reporting during peace, crisis and war. Specific system requirements for the U-2R, and tests conducted on the U-2R, apply directly to the follow-on procurement of the Advanced Synthetic Aperture Radar System airborne and ground elements for the TR-1. These tests are documented in the Descriptive Summary for Program Element 0604756F.

2. (U) Operational Test and Evaluation (OT&E): An OT&E of projects being developed within this program which concern the TR-1 Reconnaissance System will be conducted in conjunction with the TR-1 Reconnaissance System OT&E. The purpose of this OT&E is to evaluate the aggregate system capability to provide near real-time intelligence information to tactical commanders. See the TR-1 Squadron Congressional Data Sheet, Program Element 0207215F, Budget Activity #4 - Other Aircraft for detailed information. AFOTEC has no other test responsibility under this program element.

3. (U) Systems Characteristics:

(U) ADVANCED SYNTHETIC APERTURE RADAR SYSTEM (ASARS-2):

| (U) Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Search Mode | [ | [ |
| Range | | |
| Swath Width | | |
| Squint Angle | | |
| Resolution | ] | ] |

Budget Activity: #4, Tactical Programs
Program Element: #0604756F, Side Looking Airborne Radar (SLAR)

| (U) Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Spotlight Mode | | |
| Range | | |
| Spot Size | | |
| Squint Angle | | |
| Resolution | | |

* These numbers represent the practical maximum range capability of the Advanced Synthetic Aperture Radar System (ASARS-2) for image exploitation purposes per Tactical Reconnaissance Exploitation Demonstrations System (TREDS) Director message 250730Z Jul 86. However, the radar has produced imagery in search mode at

** was not specified by the AF, but was set as a goal for the contractor.

(U) TR-1 AIRCRAFT: All required operational characteristics verified by over 10 years of U-2R operation. Procurement organization will perform routine acceptance flight tests on each aircraft prior to delivery.

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| None | | | |

T&E Activity (Next 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| None | | | |

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604770F
DOD Mission Area: 217 - Land Warfare Surveillance & Reconnaissance

Title: Joint Surveillance Target Attack Radar System (Joint STARS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 297,248 | 346,559 | 238,070 | 195,325 | 1,389,995 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A critical need exists for an effective capability to delay, disrupt, and destroy first and second echelon Warsaw Pact armored forces and to hamper attempts to break through Allied positions. Also, there is a critical need for a rapidly deployable capability for use in less intense conflicts in contingency areas. To meet these needs, the Air Force and Army initiated the Joint Surveillance Target Attack Radar System (Joint STARS) with the Air Force as lead Service. Joint STARS will provide information to delay/disrupt/destroy mobile targets in the enemy second echelon. Joint STARS is unique because it is a closed loop system for real time detection, tracking, and attack of enemy ground moving targets. Using moving target indicator and synthetic aperture radar techniques, Joint STARS can detect and track both moving and fixed enemy targets. Joint STARS integrates the accurate attack of those forces by providing position updates and exact enemy locations to direct attack aircraft, artillery, and standoff missiles. The Army Corps commander requires wide area surveillance information to understand enemy force build-up and scheme-of-maneuver in order to apply effective and timely maneuver of forces, battlefield management, and targeting for tube artillery, multiple launch rocket systems and tactical missiles.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 300,000 | 337,912 | 238,296 | 195,325 | 1,381,574 |

EXPLANATION: (U) The FY 1987 reduction was due to Air Force reprogrammings. The increase in FY 88 reflects additional Congressional funding of $10.0 Million to procure a third E-8A test aircraft. This was reduced by $1.353 Million to fund balanced technology initiatives.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: This program element is closely coupled to the Joint STARS NATO Cooperative Development Project (PE 0603790F, Project 3639), the Army RDT&E Joint STARS program in PE 0604770A and the Army Joint STARS Ground Station Module (GSM) procurement in the Army Other Procurement program. Program element 0603770F, Joint STARS Advanced Development, provided risk reduction and performance improvement for target detection, accuracy, electronic counter-countermeasures and target discrimination. No funding was requested beyond FY 1986 for PE 0603770F. PEs 0603770F and 0604770F/0604770D replaced "PAVE MOVER" (PE 0603747F) and the "PAVE MOVER Engagement System" (PE 0604616F). In May 1982 OSD designated the Air Force as the lead Service and identified the Air Force and Army responsibilities for the Joint STARS program. The Joint STARS Joint Program Office (JPO) is a joint Army/Air Force program office to manage the full scale development of Joint STARS. A component of the JPO operates from Fort Monmouth, NJ.

6. (U) WORK PERFORMED BY: The Joint STARS program is managed by a Joint Program Office, ESD/JS, at Hanscom AFB, MA. The prime contractor for Joint STARS is Grumman Aerospace Corp, Bethpage, NY, through its new operating division, Grumman Melbourne Systems Divsion, Melbourne, FL. Major subcontractors are Norden Systems, Norwalk, CT, Boeing Military Airplane Co, Wichita, KS and Control Data Corp, Minneapolis, MN. MITRE Corp, Bedford, MA, assists the Joint Program Office in overall concept studies, test planning and evaluation of demonstrated results, preparation of technical specifications, and technical analyses. The Joint STARS GSM is being developed by Motorola Corp, Tempe, AZ.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0604770F, Joint STARS

A. Project Description: There is no other system planned to provide real time wide-area surveillance of the battlefield, closed loop target detection and tracking and real-time attack targeting against first and second echelon armor. Joint STARS will be the only DOD system able to provide the "electronic high ground" to the Corps and Division commanders. Joint STARS provides a two to five day advance look at enemy second echelon force build-ups, force movements, and the enemy's scheme of maneuver on the battlefield. This early information on the enemy's battle plan will allow the Corps commander to react, even before the enemy battle plan is executed, with maneuver and economy of force to engage the enemy at a time and place of the Corps commander's own choosing. Additionally, Joint STARS targeting data permits the direction of direct attack aircraft, artillery, and standoff missiles against ground targets in real time, compared with current interdiction missions which are performed on a preplanned basis. The Joint STARS will be the only DOD system able to target attack aircraft or standoff missiles against moving ground targets in near real time. This project provides full scale development of the Joint STARS, an Army/Air Force program for an airborne radar and engagement system to detect and track enemy ground movers, and direct accurate attacks against these targets using conventional weapons. The multi-function Joint STARS performs wide area battlefield surveillance, attack planning, attack control, and post attack assessment functions. The system includes multi-mode

radar, communications, and operations and control subsystems, all installed in an E-8A (formerly called C-18) aircraft, a militarized Boeing 707. The radar uses a large, electronically agile antenna to rapidly scan the areas of interest to the combat commander, using the Moving Target Indicator mode. The radar can also time share a Fixed Target Indicating mode using synthetic aperture radar technology, and can provide real-time target location updates to tactical aircraft. The radar is modular, and is constrained in weight and volume to insure that it is adaptable to both the E-8A and to follow-on aircraft. The operations and control subsystem includes the displays, computers, and weapon controllers/analysts used to exploit the wealth of radar data. The communications capabilities include various voice radios as well as data links which will transmit Joint STARS surveillance data omnidirectionally to combat commanders without delay. The E-8A will carry a self-defense suite to increase survivability in high threat environments. The self-contained E-8A concept, with radar and operations/control capabilities in one aircraft, is particularly well suited to rapid deployment contingency operations. Potential target engagement capabilities of the Joint STARS system, based on technology demonstrated by the PAVE MOVER radar of the Assault Breaker technology demonstrations, include cue vectoring of low altitude aircraft and targeting for standoff air-to-surface and surface-to-surface missiles.

The PAVE MOVER demonstration program technology has been incorporated into the Joint STARS system design. PAVE MOVER technology proved capable of detecting and tracking slow moving ground vehicles [ ] to ranges of [ ] and within [ ] abeam the aircraft. PAVE MOVER also demonstrated a small area [ ] fixed target image mode with a [ ] resolution for the detection and location of stopped vehicles. To provide a high probability of target destruction, the PAVE MOVER Engagement System used its narrow beam radar to send accurate guidance commands to both standoff missiles and attacking aircraft. Total system strike accuracy using the PAVE MOVER relative guidance was designed for [ ] Circular Error Probable (CEP) at [ ] PAVE MOVER provided accurate guidance for surface-to-surface missiles carrying anti-armor sub-munitions. Missiles were directed within a [ ] dispensing area above a moving armored column at a range of [ ] PAVE MOVER also cue-vectored an F-4 tactical aircraft on low altitude [ ] bombing runs against moving armor, with a CEP of [ ]

B. (U) <u>Program Accomplishments and Future Efforts:</u>

(1) (U) <u>FY 1987 Accomplishments:</u> The airborne segment consisting of the E-8A, radar, operations and control, and communications subsystems completed system critical design review. Militarization of the first RDT&E E-8A aircraft has been completed. Brassboard hardware elements completed development, test and laboratory integration. The components of the operations and control subsystem have been tested and integrated. Components of the communications subsystem have been integrated into the test aircraft. Roof top tests of the first radar began. Software coding began. Logistics repair analysis were continued and analysis of support equipment and pre-operational spares began. Ground terminals of the surveillance and control data link were integrated into the Ground Station Module (GSM), which is being developed by Motorola under a separate Army contract. Planning for European Operational Field Demonstration began. The Operational Utility Evaluation (OUE) computer simulations and analysis to support the Milestone IIB were completed. OUE emphasis was on system survivability, battlefield management, situation development and targeting. The full scale development of the Joint STARS GSM continued.

(2) (U) FY 1988 Program: The Milestone IIB force structure and product improvement review will be completed. Radar, operations and control console and communications subsystems hardware fabrication and integration will be completed. Contractor engineering flight testing will begin. Software integration testing and qualification will continue. Ground beacon test articles will be delivered. System logistics development and support will continue with emphasis on peculiar support equipment development, maintenance planning, provisioning, pre-operational logistics support and technical manual development activities. Ground testing and TEMPEST testing will be completed. Detailed test planning for the Operational Field Demonstration (OFD) in Europe will continue. The E-8A self defense suite effort to integrate and field appropriate off-the-shelf radar warning receiver and other counter-measures equipment will begin. Army Ground Station Module (GSM) hardware will be delivered for integration testing with the E-8A. Production planning will continue. Beddown planning will continue. The request for this program is based on a class II cost estimate. An initial Category II (mature) Independent Cost Analysis (ICA) was performed prior to the Joint STARS DSARC IIA in 1985. The full scale development fixed price contract was negotiated and awarded in September 1985.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Contractor system level testing will begin. Incremental software audit/qualification reviews will begin. Peculiar Support Equipment, technical manuals and pre-operational spares will be delivered to the test program. Reliability improvement efforts will continue as high failure rate piece parts are identified and modifications made to increase system effectiveness. Beddown plans will be finalized and the military construction design process will begin. The E-8A self defense suite integration will continue. Detailed planning for testing and the deployment for the Operational Field Demonstration (OFD) will continue. The Army will conduct an in-process review production decision for the GSM.

(4) (U) Program to Completion: The government test team will be fully manned and trained for the development and operational testing and evaluation. Final Configuration Audits and Physical Configuration Audits will be completed. System level performance will be completed following contractor systems level testing. The combined government Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E) will be completed. The Joint STARS program, including the European OFD, will complete initial full scale development in FY 1991. Additional research and development efforts for enhanced capabilities will continue after the initial program is completed. A production program request for proposal will be released and the response will be evaluated by the government. An independent cost analysis for the production program will be performed. A low rate initial production decision to meet an Early Operational Capability (EOC) during FY 1994 will be conducted in FY 1991. Production Readiness Reviews will be completed in FY 1991. The Operational Utility Evaluation field tests and command post exercises, will be completed prior to the Milestone III full production decision. E-8A production will be completed.

C. (U) Major Milestones:

| | Milestones | Dates |
|---|---|---|
| (1) | (U) Release of Modified Full Scale Development Request for Proposals | September 1984 |
| (2) | (U) Contract Award for Full Scale Development | September 1985 |

| | | | | |
|---|---|---|---|---|
| (3) | (U) | Preliminary Design Review, Hardware | | May 1986 |
| (4) | (U) | Preliminary Design Review, Software | | February 1987 |
| (5) | (U) | Critical Design Review, Hardware | | March 1987 |
| (6) | (U) | First System Flight | | April 1988 |
| (7) | (U) | Critical Design Review, System Software | *(August 1987) | November 1988 |
| (8) | (U) | Combined Govt Development/Initial Opnl Test & Eval Begins | *(November 1989 | November 1990 |
| (9) | (U) | European Operational Field Demonstration Begins | *(October 1989) | FY 1990/1991 |
| (10) | (U) | Full Production Decision | *(October 1990) | November 1991 |
| (11) | (U) | Early Operational Capability (EOC) | *(FY 1992) | FY 1994 |

* Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes

(7) (U) The system software CDR was delayed due integration problems. The contractor had to restructure his software integration plan which caused a 14 month delay.

(8) (U) Government testing date moved to correspond with a necessary extension of the Full Scale Development (FSD) program due to the restructured software development tasks.

(9) (U) The European Operational Field Demonstration will take place at a point in FY 1990/1991 when the contractor baselines a Moving Target Indication capability.

(10) (U) Full production decision date moved to correspond with completion of government testing and final reports of initial operational capability.

(11) (U) Early Operational Capability date was moved to FY 1994 to correspond with the new delivery schedules based on the slipped production program.

9. (U) COOPERATIVE AGREEMENTS: The Air Force initiated a Joint STARS NATO Cooperative R&D program (PE 0603790F, Project 3639) in FY 1987. This program funds promising development and study efforts in a cooperative R&D program to strengthen ties between the US and our Allies, avoid wasteful duplication of effort among the NATO Allies and enhance NATO Rationalization, Standardization and Interoperability. This program exploits the Joint STARS system architecture of partitionable subsystems which are suited to confederated development. This initiative tailors cooperative development to system upgrades which suit the needs and interests of the participating countries. In addition, the Airborne Radar Demonstrator System (ARDS) is a cooperative agreement for demonstrating a combined ground and airborne radar for wide-area surveillance. The agreement to conduct the demonstration has been signed by the United States, France and the United Kingdom. The Federal Republic of Germany is expected to participate as an observer in the future. The US Army is the executive agent for the ARDS. Details of this project are provided in the Army documentation for PE 0604770A.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604779F    Title: Joint Interoperability of Tactical Command and Control Systems (JINTACCS)
DOD Mission Area: 344 - Tactical Command and Control    Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING):($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 9,331 | 6,017 | 6,079 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: JINTACCS is a joint interoperability program to improve the operational effectiveness of service (Navy, Army, Air Force, and Marine Corps) Tactical Command & Control Systems used in support of joint operations. The program element supports Air Force participation in the JINTACCS Program with the Marine Corps, Navy, Army, and the Joint Tactical C3 Agency which acts as the Executive Agent. Service and agency activities are governed by jointly agreed upon and Joint Chiefs of Staff approved documentation including Technical Interface Concepts and Technical Interface Design Plans. Close liaison across each of the JINTACCS programs precludes duplication of efforts. Elements of the Tactical Air Intelligence System, E-3, and Joint Tactical Information Distribution System (JTIDS) participate in this program. The JINTACCS program (formerly GAMO) is directed by Joint Chiefs of Staff Memorandum (SM) 205-71 dated 1 April 1971, as modified by a Secretary of Defense memorandum, "Reorganization of the DOD Program to Achieve Interoperability of Tactical Command and Control Systems for Ground and Amphibious Military Operation (GAMO)," dated 2 Aug 1977. The program complies with requirements of Department of Defense Directive 4630.5, "Compatibility and Interoperability of Tactical Command, Control, Communications and Intelligence Systems." The structure of the program is established by the JINTACCS Program Summary which is reviewed and approved annually by the Assistant Secretary of Defense for Command, Control, Communications and Intelligence. Tactical Air Forces Required Operational Capability 306-74 (validated 4 Oct 74) is the requirement supporting JTIDS.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 9,382 | 6,040 | 6,085 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Service and Agency related JINTACCS program elements/projects are: PE 0604780M, Joint Interoperability for Tactical Command Control Systems; PE 0604779N, JINTACCS Program; PE 0604779A, JINTACCS; PE 0208045D, $C^3$ Interoperability (Joint Tactical $C^3$ Agency); and PE 0208298D, Management Headquarters.

6. (U) WORK PERFORMED BY: The Tactical Air Command (HQ TAC/DRI), Langley AFB, VA, is coordinating and implementing authority for Air Force participation in the Joint Chiefs of Staff JINTACCS Program. Management responsibility for R&D funding is assigned to the Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. The Tactical Air Command provides operational support, including a Participating Test Unit at the Air Force Tactical Systems Interoperability Support Center at Langley AFB, VA, to support compatibility and interoperability testing and operation effectiveness demonstrations. The JINTACCS contractors are Martin Marietta, Denver, CO; and the MITRE Corporation, a Federal Contract Research Center, located at Bedford, MA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604779F, Joint Interoperability of Tactical Command and Control Systems:

A. (U) Project Description: Joint Interoperability of Tactical Command and Control Systems was started in August 1977 as the successor to the Ground and Amphibious Military Operation Program. Its purpose is to improve the operational effectiveness of the Services (Army, Navy, Air Force and Marine Corps) command and control systems used in support of joint operations through the 1980s. Also incorporated are the intelligence facilities of the National Security Agency and the Defense Intelligence Agency. NATO interoperability considerations were added in 1978. The Services and Agencies use the program to develop common interface standards and to modify their command and control equipment and procedures as necessary to insure systems interoperability, compatibility and operational effectiveness. To facilitate management, the program is divided into the following functional segments: intelligence, air operations, maritime operations, fire support, operations control, and Tactical Digital Information Link "J" (TADIL J). Within the Air Force, the primary command and control facility interfaces to be analyzed and defined exist within the Tactical Air Control Center (TACC), Control and Reporting Center/Post, Air Support Operations Center, Airborne Warning and Control System, Airborne Battlefield Command and Control Center, and the intelligence element supporting the TACC. An Air Force test facility known as the Participating Test Unit has been established to evaluate Air Force modified command, control and communications elements, to support testing and demonstrations, and to provide ongoing configuration control. The JINTACCS program follows a procedure where Technical Interface Concepts are defined and the initial Technical Interface Design Plans - Test Editions (TIDP-TE) are completed. Following modification of the test systems, Developmental Certification Testing is performed, the TIDP-TE modified, Operational Effectiveness Demonstration conducted, and a final TIDP published for incorporation into JCS publications. The overall goal is to achieve joint compatibility and interoperability among tactical command and control systems from each service.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Program Accomplishments: Continues interface planning, analysis and design efforts, the development of the Simulation, Monitoring, Analysis, Reduction, Test System (SMARTS) capability for the 552 AWAC Wing, and the development and testing of the combat service support functional segment. Also, development of the Tactical Digital Information Link "J" (TADIL-J) test capability for the Air Force Participating Test Unit (PTU) began.

(2) (U) FY 1988 Program: Interface planning, analysis and design efforts will continue. The SMARTS for the 552nd AWAC Wing will be completed. Development and testing for the combat service support functional segment will continue as well as development of the TADIL-J capability for the Air Force PTU. Estimates for the FY 1988 effort are based on negotiated contract (cost estimating category I) or on engineering planning estimates (cost category III).

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Funds are requested to continue the development of the TADIL-J capability, integrate TADIL-J equipment, and begin simulation testing of the TADIL-J message standard. Estimates for the FY 1989 effort are based on negotiated contracts (cost estimating category I) or on engineering planning estimates (cost category III).

(4) (U) Program to Completion: The continuing program will support functional segment testing for compatibility and interoperability and operational effectiveness demonstrations. The TADIL-J test capability for the PTU will be completed. Technical interface design plans will be updated and subsequently incorporated as standards into Joint Chiefs of Staff Publication 2.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Intelligence Operational Effectiveness Demonstration | | May 1981 |
| (2) (U) Air Operations/Intelligence Operational Effectiveness Demonstration | | May 1983 |
| (3) (U) Operations Control, Fire Support, Maritime, Air Operations and Intelligence Combined Functional Segment - Operational Effectiveness Demonstration | | May 1985 |
| (4) (U) JINTACCS Message Text Formats Joint Service Implementation | | September 1986 |
| (5) (U) Tactical Digital Information Link "J" (TADIL-J) Development Certification Testing (DCT) start | *(July 1990) | July 1991 |
| (6) (U) TADIL-J DCT complete | *(July 1992) | July 1993 |

* Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Changes:

(5) and (6) (U) Certification testing slips due to a slip in the JTIDS terminal IOC.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207129F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: F-111 Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 15,790 | 18,926 | 21,541 | 56,743 | 311,023 |
| 2952 | F-111 Avionics Intermediate Shop (AIS) | 1,641 | 1,400 | 0 | 0 | 93,750 |
| 2962 | F-111 Avionics Modernization Program (AMP) | 750 | 1,926 | 3,960 | 33,430 | 147,380 |
| 3079 | F-111 Digital Flight Control System (DFCS) | 13,399 | 15,600 | 17,581 | 23,313 | 69,893 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides funds for development activities associated with the F-111 aircraft. Project 2952 is an engineering effort to replace the existing F-111 AIS Automatic Test Stations which have become technologically obsolete, unreliable, and logistically unsupportable. The F/FB-111 AMP (Project 2962) is a reliability/maintainability improvement to the bomb/navigation system required to reduce maintenance and support costs associated with high failure, high cost, and technologically outdated components. Project 3079, the DFCS is a development effort to replace the analog flight control system with a digital system to eliminate safety deficiencies (uncommanded flight maneuvers) and improve reliability and maintainability.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 15,790 | 25,656 | 20,136 | TBD | TBD |
| Aircraft Procurement* | 211,000 | 195,10 | 99,400 | 203,700 | 1,039,800 |

EXPLANATION: (U) FY 1988 RDT&E decrease is the result of Congressional actions. FY 1989 RDT&E increase was due to a reprogramming to support additional AMP development. "To completion" numbers became available with definitization of the DFCS contract. Procurement cost differences (FY 1987 and out) reflect rescheduling of F-111 AMP kit buys.

* Includes F-111 Avionics Modernization Program (AMP) kit costs and DFCS

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| F-111 Avionics Modernization Program (AMP) | | | | | |
| Aircraft Procurment: | | | | | |
| Funds | 211,000 | 195,100 | 109,400 | 270,500 | 1,039,800 |
| Quantities (Kits) | (120) | (60) | (35) | (27) | (388) |
| F-111 Digital Flight Control System (DFCS) | | | | | |
| Aircraft Procurement: | | | | | |
| Funds | 0 | 0 | 0 | 108,700 | 108,700 |
| Quantities (kits) | (0) | (0) | (0) | (400) | (400) |

5. (U) RELATED ACTIVITIES: Not Applicable

6. (U) WORK PERFORMED BY: The F-111 Avionics Intermediate Shop (AIS) contractors are Westinghouse, Baltimore, MD, and Bendix, Teterboro, NJ. The F-111 AMP contractors are General Dynamics Corporation, Ft. Worth, TX for the FB-111 aircraft; and Grumman Aerospace Corporation, Bethpage, NY for the F-111A/E and EF-111 aircraft. The DFCS contractor is General Dynamics Ft Worth, TX. The F-111 System Manager is located at Sacramento Air Logistics Center, McClellan AFB, CA. The DFCS development effort is managed at Aeronautical Systems Division, Wright-Patterson AFB, OH. The F-111 AIS development effort is managed at San Antonio Air Logistics Center, Kelly AFB, TX.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2962, F-111 Avionics Modernization Program (AMP): The F/FB-111 AMP is a low risk reliability/maintainability upgrade to the bomb navigation system of the FB-111, F-111 A/E/D/F, and EF-111. This modification involves the substitution, modification, and repackaging of 16 Line Replaceable Units in the following subsystems: Inertial Navigation System, Terrain Following Radar, Attack Radar, Doppler Radar, Controls and Displays, and Data Transfer Unit. This modification is expected to raise the mean time between failure of the overall system from the current 5 hours to approximately 20 hours and will ensure system supportability into the 1990's. In FY 1987 this project will provide for the production incorporation and retrofit of the changes resulting from the CERT and any residual tasks remaining following the program management responsibility transfer of the radars. In addition,

required to support Avionics Modernization Program (AMP) terrain following and attack radar line replaceable units at the intermediate maintenance level. All TPS and F-111 AMP engineering development efforts will be compelted in FY 1989.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3079, F-111 Digital Flight Control System (DFCS)

A. (U) Project Description: The DFCS is a Class IVA safety modification that replaces the electronic portion of the F/FB/EF-111 flight control system with a modern state-of-the-art digital computer and sensors. This project will also improve the critical interfaces of the flight control system by incorporating the on-board autopilot and low altitude monitor, and monitoring the terrain following radar systems. As a by-product of this safety modification, the system reliability of the flight control system will be improved.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Source selection was completed and a contract awarded to General Dynamics Fort Worth TX in 2Q FY 1987 for FSD. Initial design began, contractor manpower was increased and Preliminary Design Review was completed on schedule.

(2) (U) FY 1988 Planned Program: Design and system engineering development activities will peak during the first full year of DFCS FSD. Engineering development models will be constructed and the Critical Design Review was conducted to finalize functional design paramenter. Testing of hardware prototypes and software simulation activities will begin.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Prototypes for safety of Flight testing, qualification testing, and test aircraft installation will be delivered. The first F-111 test aircraft will be modified and undergo functional flight test. Development, Test, and Evaluation (DT&E) will begin for the F-111F or FB-111A aircraft.

(4) (U) Program to Completion: Development Test and Evaluation of the first modified F-111 aircrft will be completed and Initial Operational Test and Evaluation will be conducted. Three prototype aircraft will undergo flight testing. Low rate initial production will provide initial kitproof production kits in FY 1991. Full rate production and modification of all F-111 models will complete in FY 1994.

C. (U) Major Milestones:

Program Element: 0207129F
DOD Mission Area: 232 - Close Air Support Interdiction

Title: F-111 Squadrons
Budget Activity: 4 - Tactical Programs

| Milestones | Dates |
|---|---|
| (1) (U) DFCS Contact Award | February 1987 |
| (2) (U) DFCS Critical Design Review | February 1988 |
| (3) (U) DFCS Flight Test | 3rd Quarter FY 1989 - 2nd Quarter FY 1991 |
| (4) (U) Start DFCS Kit Deliveries | 2nd Quarter FY 1991 |

9. COOPERATIVE AGREEMENTS: Not Applicable.

# AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207130F
DOD Mission Area: 221 - Counter Air

Title: F-15 Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 153,347 | 105,588 | 89,056 | 196,263 | 3,335,222 |
| 0131 | F-15 Squadrons | 74,647 | 75,593 | 71,087 | 196,263 | 3,041,179 |
| 0132 | F-15E Unique Cap. | 78,700 | 29,995 | 17,969 | 0 | 294,043 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The F-15 is a high performance, highly maneuverable fighter equipped with long-range look-down radar and a balanced mix of air-to-air weapons to provide medium range, all weather and close-in kill capability. Designed specifically to gain and maintain air superiority, the F-15 has significantly upgraded USAF capability in the counter-air and air defense missions. The F-15E retains the basic air-to-air capability and adds systems necessary to meet the requirement for all weather, deep penetration and night/under-the-weather air-to-surface attack. Continued production of the F-15E satisfies force structure requirements for deep interdiction.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 156,069 | 118,564 | 69,340 | 180,363 | 3,315,636 |
| Aircraft Procurement | 1,760,165 | 1,654,900 | 1,734,000 | 10,098,300 | 33,754,628 |

EXPLANATION: (U) The FY 1989 RDT&E and procurement requirements are based on a "grassroots" estimate completed in November 1987 and reflect a restructured program as a result of Congressional reductions in FY 1987 & 1988. RDT&E changes are primarily due to the addition of the VHSIC central computer and SEEK EAGLE weapons verification requirements. Production changes are attributable primarily to decreasing the FY 1989 production rate from 42 aircraft to 36 aircraft. In addition, there are increased cost estimates for the ALQ-135 Internal Countermeasures System, technical order maintenance, the VHSIC central computer, and RF compatibility efforts.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds | 1,766,565 | 1,560,700 | 1,505,914 | 10,573,300 | 33,896,700 |
| Quantities | 42 | 42 | 36 | 264 | 1266 |

5. (U) RELATED ACTIVITIES: The Tactical Electronic Warfare System for F-15 application is being developed in PE 0604739F, Tactical Protective Systems. AIM-9M and AIM-7M (Advanced Monopulse Seeker) air-to-air missiles are being procured for use on the F-15 and other aircraft under PE 0207161F, Tactical Air Intercept Missiles. The Joint Tactical Information Distribution Systems (JTIDS) is being developed for use on multiple aircraft including the F-15 under PE 0604754F, JTIDS. The Advanced Medium Range Air-to-Air Missile (AMRAAM) is being developed under PE 0604314F, AMRAAM. The F-15 Ring Laser Gyro inertial navigation unit is being developed for F-15E production and subsequent F-15A-D retrofit under PE 0604201F, Aircraft Avionics Equipment Development. The Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) is being developed for the F-15E under PE 0604249F, Night/Precision Attack. The Improved Performance Engine is being developed under PE 0604223F, Alternate Fighter Engine.

6. (U) WORK PERFORMED BY: The F-15 and F-15E development program is being managed by the F-15 Program Office, Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. McDonnell-Douglas Corporation, St. Louis, MO, is the prime contractor for development and production of the F-15 aircraft. Pratt & Whitney division of the United Technology Corporation, West Palm Beach, FL, is the engine contractor. Hughes Aircraft Company, Culver City, CA, is the radar subcontractor to McDonnell-Douglas Corporation.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0131, F-15 Squadrons

A. (U) Project Description: The F-15 is the most capable air superiority fighter in the world today. As such, it is the cornerstone to the accomplishment of all other tactical missions. With conformal fuel tanks, the F-15 can deploy worldwide with minimal tanker support and arrive in a combat ready configuration. However, the Soviet/Warsaw Pact threat continues to grow quantitatively and qualitatively with their new generation of aircraft possessing all-weather detection and kill capabilities. To maintain the F-15's superiority against the threat in the mid-1980s and through the 1990s, avionics, armament, airframe, and engine improvements are required. Avionics changes which exploit proven technological advances are being incorporated into the F-15 to provide expanded air combat identification capability, updated electronic warfare suite, and incorporation of improved communication/identification equipment. In addition, this project develops enhanced capability for the secondary air-to-ground role. Improvements include a higher maximum takeoff weight, air-to-ground modes for the radar, an improved inertial navigation system, and increased capacity generators. These improvements are grouped into a comprehensive, cost effective Multi-Staged Improvement Program (MSIP). In addition, overall combat capability will be increased by integration of an Increased Performance Engine (IPE).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 RDT&E funds were used for the completion of development and testing of the MSIP simulator. Further, FY 1987 continued development and testing of integrated MSIP systems and MSIP radar ECCM updates, development of Tactical Electronic Warfare System (TEWS) support equipment and weapons certification for new weapons. Integration of the IPE and RF compatibility efforts were started.

(2) (U) FY 1988 Program: FY 1988 RDT&E efforts include continued development and testing of the improvements initiated in FY 1987 and prior. These improvements are required to meet the evolving air-to-air threat and enhance the inherent air-to-ground capability of the aircraft. The upgraded systems also serve as a baseline from which to add the unique systems necessary for the F-15E mission. Planned efforts include final design, test and checkout of all MSIP changes and peculiar support equipment to ensure system compatibility, continued Improved Performance Engine integration, RF compatibility efforts, and continued Electronic Counter-counter Measure (ECCM) enhancements. The VHSIC central computer (CC) program started to solve memory and throughput limitations.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 RDT&E program will continue flight test and RDT&E tasks associated with Seek Eagle, Phase IV TEWS integration, ALQ-135 Band 1.5/3 jammer integration, TEWS Intermediate Support System (TISS) development, Increased Performance Engine integration, VHSIC CC, RF compatibility, advanced algorithm dual mode recognizer, memory module test system and radar module test station. The FY 1989 RDT&E request is based on in-depth "grassroots" estimates (Category I--comprehensive) completed in November 1987.

(4) (U) Program to Completion: Program funding will enable completion of tasks underway including radar improvements, ECCM improvements, added capability for electronic warfare test equipment, and additional flight testing for safety and operational deficiency correction.

C. (U) F-15A-D Major Milestones:

| Milestones | | Date |
|---|---|---|
| (1) (U) Advanced Development Initiated | | January 1970 |
| (2) (U) Initial Contract | | January 1970 |
| (3) (U) Critical Design Review | | April 1971 |
| (4) (U) Delivery & 1st Flight, 1st Aircraft | | July 1972 |
| (5) (U) Long Lead Production Decision | | October 1972 |
| (6) (U) Full Production Decision | | February 1973 |
| (7) (U) Initial Operational Capability | | July 1975 |
| (8) (U) Multi-Staged Improvement Program (MSIP) Initiated | | June 1982 |
| (9) (U) Delivery, 1st F-15C/D MSIP Aircraft | | June 1985 |
| (10) (U) Planned Delivery, last F-15C/D MSIP aircraft | *(May 1988) | December 1988 |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone changes

(10) (U) Last delivery of F-15C/D MSIP aircraft slipped 7 months to correct contaminated wire braiding.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0132, F-15E Unique Capability

A. (U) Project Description: The F-15E will be a high performance, highly manéuverable fighter equipped with a mix of air-to-air and air-to-surface weapons. The F-15E configuration will include missionized cockpits, Low Altitude Navigation, Targeting, and Infrared for Night (LANTIRN) capability, automatic terrain following, and other improvements. These improvements are necessary to fulfill an urgent need for an aircraft which retains basic air superiority capability, but can provide all weather navigation, deep penetration, and night/under-the-weather attack with large air-to-surface weapons payloads. This project develops and tests the changes required by the F-15E unique mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 RDT&E program continued full scale development and testing of the F-15E systems and support equipment started in FY 1986 and prior. F-15E hardware/software development continued with increased emphasis on engineering redesign to resolve problems identified in FY 1986 testing. The first flight of the F-15E was successfully completed in December 1986. Initial flight testing and in-depth ground testing was accomplished.

(2) (U) FY 1988 Program: The FY 1988 RDT&E program continues F-15E hardware/software development effort with emphasis on engineering redesign to resolve problems identified in FY 1987 testing. Funding will provide for final development, integration ground and flight testing associated with F-15E subsystems and weapons integration.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 RDT&E on the F-15E will be complete. Planned efforts include resolution of issues identified during the FY 1988 RDT&E program, incorporation of any necessary software changes, and documentation of RDT&E results. The FY 1989 RDT&E request is based on in-depth grassroots estimates (Category I-comprehensive) completed in November 1987.

(4) (U) Program to Completion: Program funding completed in FY 1989.

C. (U) F-15E Major Milestones:

| Milestones | | Date |
|---|---|---|
| (1) (U) F-15/F-16 Flight Evaluation Complete | | June 1983 |
| (2) (U) Statement of Need Validated | | January 1984 |
| (3) (U) F-15E Development Decision | | February 1984 |
| (4) (U) Award Development Contract | | April 1984 |
| (5) (U) Delivery & First Flight, F-15E #1 | | December 1986 |
| (6) (U) F-15E Initial Operational Capability (IOC) | | September 1989 |
| (7) (U) Planned Delivery, last F-15E aircraft | *(July 1997) | September 1997 |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone changes

(7) (U) Last delivery of F-15E aircraft slipped due to reduced procurement in FY 1989.

10. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Test and Evaluation Data

(U) The F-15 test program encompasses Contractor Development Test and Evaluation (CDT&E), Air Force Development Test and Evaluation (AFDT&E), Air Force Initial Operational Test and Evaluation (IOT&E) and Follow-on Operational Test and Evaluation (FOT&E). The purpose of CDT&E and AFDT&E was to provide necessary test and analysis data to assure that an operational air superiority weapon system would be available at the earliest practical time. Test objectives addressed compliance with specifications, established performance capabilities, evaluated handling quantities, etc. IOT&E was conducted throughout Development Test and Evaluation (DT&E) to evaluate the operational capability and suitability of the F-15 weapon system. A portion of Tactical Air Command's (TAC) IOT&E involved their participation in eleven F-15 Air Force Preliminary Evaluations (AFPEs). Additionally, seven Initial AFDT&Es were conducted during DT&E to permit Air Force Flight Test Center and TAC pilots to evaluate contractor fixes of mandatory correction items discovered during AFPEs and to accomplish early Air Force developmental and operational test objectives. Eighteen F-15As and two F-15Bs (2-seat version) were dedicated to the DT&E/IOT&E tests.

1. (U) Development Test and Evaluation (DT&E): As of 31 May 1987, the USAF and McDonnell Douglas DT&E test teams had accumulated 12,920 test flights and 16,628 flight hours on F-15 test aircraft during 177 months of F-15 DT&E. This paragraph summarizes the significant DT&E accomplishments in the F-15 program from the beginning of Full-Scale Development in January 1970 through May 1987. The air vehicle critical design review and the avionics equipment development review were completed in April and June 1971, respectively. From July 1971, efforts were directed to fabrication of components and flight test airplanes and extensive ground testing of subsystems. Three demonstration milestones were completed in February 1972, including the Engine/Inlet Compatibility Test, the Structural Test of Major Subassemblies, and the Engine Preliminary Flight Rating Test (PFRT) Milestones. To obtain increased engine efficiencies over the PFRT engine (Series I configuration) the Air Force decided, in March 1972, to use the alternate design being carried as a parallel effort. This engine became Series II, the configuration planned for Military Qualification Tests and for subsequent production. F-15 first flight occurred on 27 July 1972 beginning a highly successful flight test program. The flying qualities Air Force Preliminary Evaluation (AFPE) was completed in September 1972, with favorable results. The initial Airborne Avionics Performance Milestone was completed on 2 December 1972. Two structure demonstration milestones were completed in January 1973, including the Fatigue Test to One Lifetime and Static Test to Critical Conditions. The F100 engine endurance qualification test, delayed beyond planned completion date of February 1973 by technical problems, was successfully completed 12 October 1973.

(U) All major structural testing milestones were met when the fatigue tests to three and four lifetimes were completed in March 1974. The AFDT&E began at Edwards AFB in February 1974. The external Stores Flutter Release Milestone was completed in August 1974. With the exception of a single aircraft conducting limited armament follow-on testing, all CDT&E was completed in November 1974. All high angle-of-attack and spin testing was completed in August 1975. The Equipment Qualified Milestone was completed in March 1977, and the Aerospace Ground Equipment In-Place

Milestone was completed in May 1977. Flight evaluation of the Air Intercept Missile Evaluation/Air Combat Evaluation changes to the computer software, F-15/F-16 radar mutual interference tests, and the AIM-9L integration effort were completed in 1978.

AFDT&E of the AN/ALR-56 Radar Warning Receiver (RWR) "New Threat" program was completed and an interim flight test report published in 1978. The New Threats consisted of three major improvements. One feature allows the ALR-56 to sort out and analyze capability. A second modification gives increased capability to detect threats that are The final change, termed Successful operation of the was demonstrated. However, the software tape still had New Threat related problems as well as some carry-over deficiencies from the current Operational Flight Program. Further development and testing was required before release. The AN/ALR-56A version B is fielded.

(U) The AN/ALR-56C RWR update is a normal development program with Quick Reaction Capability (QRC) production acceleration. The update provides an expanded reception envelope to cover current threats and a fast timing receiver to detect new agile airborne interceptor (AI) threats. DT&E/IOT&E flight testing is scheduled through 2nd quarter FY 1988. Initial fielding of the system occurred in December 1986 at the 33rd Tactical Fighter Wing, Eglin AFB, FL.

The AN/ALQ-135 Internal Countermeasures Set (ICS) update program is a QRC program to add a Band 3 jammer for Electronic Countermeasures against Compass Glory threats. This program replaces one of the existing Band 2 systems with a Band 3, thereby increasing frequency coverage of the ICS from the current system Upper hemispheric coverage and sophisticated jamming techniques are also included. Feasibility demonstration testing with a modified AN/ALR-56A RWR was completed in January 1984. Combined DT&E/IOT&E of the system began in June 1986. This testing will initially be "stand alone" ICS testing and will evolve to an integrated test involving the AN/ALR-56C and AN/ALE-45 Countermeasures Dispenser. Target date for completion of the fully integrated Tactical Electronic Warfare System testing is the 2nd Qtr FY 1988.

(U) In 1978, CDT&E and AFDT&E of the Jet Fuel Starter air start capability were completed. Testing under the F100 Engine Component Improvement Program, including solutions to the F100 stall/stagnation problem, continued throughout 1979 and 1980. The susceptibility of the F100 engine to compressor stalls followed by stagnations and the resultant durability problems have been areas of major concern. With incorporation of fixes, the F-15 stall/stagnation rate of 1.0 incident per 1000 engine flight hours was reduced to .5 incident per 1000 engine flight hours. Development and test of the F-15 C/D model, Production Eagle Package 2000 improvement (2,000 lbs additional internal fuel, provisions for conformal fuel tanks and capability for higher takeoff gross weight), which was initiated in mid-1976, was completed in late 1980. CDT&E and AFDT&E of the C/D model, which began in February and May 1979, respectively, were completed in 1980.

(U) Finally, development and test of the programmable signal processor (PSP) for the F-15 radar, which began in 1978, continued through 1980. While containing some minor discrepancies, the first PSP operational flight program delivered in May 1980 was as good or better than current aircraft radar capabilities. These discrepancies were

corrected with a tape revision in October 1980. The development of the Raid Assessment Mode (RAM) took longer than originally expected and was not incorporated until May 1981.

(U) The F-15 Programmable Signal Processor (PSP) Radar Improvement Program (PRIP) which began in June 1981 has been completed. The Engineering Change Proposal (ECP) 1518, Phase I DT&E at Edwards was initially completed 1 August 1983. This tape was released to Nellis AFB for Tactical Air Command Operational Test and Evaluation (TAC OT&E) and to St Louis for production acceptance flights. Problems in the Phase I tape were identified during OT&E and McAir production acceptance flights. The tape was returned to DT&E. The problems were corrected and production incorporation of the Phase I tapes began in July 1984. ECP 1518 Phase II DT&E was completed at Edwards AFB. The Phase II tape has also completed OT&E and been released to the tactical forces.

(U) DT&E for ECP 1833 (FY 1985 Radar Tape) started in March 1985. However, due to higher priorities, only 75 percent of the original capabilities will be incorporated in Phase I. This tape was available to the field in June 1986.

(U) The Derivative Fighter DT&E test program which began in November 1982 was completed in May 1983. The Derivative Fighter Flight Test Program involved four aircraft and accomplished initial air-to-surface stores carriage/separation, F-15 performance and flying qualities with conformal fuel tanks (CFT) and air-to-surface stores, avionics integration including high resolution radar, rear cockpit evaluation, weapons delivery and an operational utility evaluation. Because of high angle-of-attack (AOA) problems with CFTs, additional flights were required. The follow-on CFT high AOA flight test program was completed in July 1983 and the 30 units AOA restriction on CFT equipped aircraft in the air-to-air configuration was removed. With this restriction eliminated, AFOTEC re-flew the Derivative Fighter Air-to-Air Operational Utility Evaluation at Nellis AFB during June 1983. Heavy gross weight taxi testing was completed in August 1983. Initial BRU-26 flight tests were accomplished during the Derivative Fighter Flight Test Program and are continuing under Seek Eagle. Limited flight testing of tangential weapons carriage on CFTs was completed during August 1983. Verification of a significant drag reduction compared to the BRU-26 rack was accomplished.

(U) On 4 April 1985, aircraft 84-0042 (D-50) arrived at Eglin AFB, FL to begin F-15/Advanced Medium Range Air-to-Air Missile (AMRAAM) integration testing. Twelve flights were flown. The initial objective of establishing a baseline for the Multi-Staged Improvement Program (MSIP) F-15 avionics system was successfully accomplished. Unfortunately, D-50 crashed in December 1985. This setback considerably delayed the F-15/AMRAAM integration program. Eglin AFB requested and received another MSIP configured F-15 (aircraft 84-0018). This aircraft completed modification and checkout in August 1986. The present AMRAAM schedule calls for Full-Scale Development to continue through September 1988. Using data from the FSD program, an F-15/AMRAAM Radar Operational Flight Program (OFP) will be developed by Warner-Robins Air Logistics Center at Edwards AFB, CA. This tape will be available by F-15/AMRAAM Initial Operational Capability now scheduled for October 1989.

(U) The F-15E test program began in January 1985 with Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) loads wind tunnel testing at Arnold Engineering Development Center (AEDC). The first Conformal Fuel Tank (CFT) Tangential Carriage loads testing began in October 1985. The ACM-65 (Maverick) and B-61 (nuclear) wind tunnel tests were completed in August 1986. Initial F-15E Seek Eagle wind tunnel tests were completed November 1986. The Phase I stores separation flight test was completed in May 1986. The purpose of this test was to evaluate store

separation from the upper row, tangential carriage position of the -4 Conformal Fuel Tank (CFT) (prototype). Phase II stores separation flight tests from the lower row began in May 1987. First flight of an F-15E occurred in December 1986 on F-15E#1. It will test the triple redundant digital flight controls, inertial navigation system, radar and weapons integration. F-15E#2 had its first flight in May 1987. It will test the 9g str cture and Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) integration.

(U) Air Force Development Test and Evaluation (AFDT&E) Reports

1. May 1975, AFFTC-TR-75-6, AFPE of the F-15 TEWS System
2. January 1976, AFFTC-TR-75-32, F-15A Approach-To-Stall//Post-Stall Evaluation
3. July 1976, AFFTC-TR-76-24, F-15 AFDT&E of Armament/Weapons Delivery System
4. July 1977, AFFTC-TR-76-48, F/TF-15A Flying Qualities, AFDT&E
5. July 1977, AFFTC-TR-77-7, F-15 Performance AFDT&E
6. August 1977, AFFTC-TR-77-4, F-15 AFDT&E TEWS Evaluation
7. 6 September 1977, Air Intercept Evaluation (AIMVAL) Vol I-VI by Rear Admiral Ernest E. Tissot, USN, and Major General James R. Hildreth, USAF
8. February 1978, ACEVAL/AIMVAL Joint Test Force, Néllis AFB Vol I-IV by Rear Admiral Robert P. McKenzie, USN, and Major General James R. Hildreth, USAF
9. 1 April 1978, AFFTC-TR-77-40, F-15 AFDT&E Air-to-Air Missile Evaluation (AIM-9L)
10. 10 May 1978, JFS Air Start Report AFFTC Directive 78-129
11. November 1979, AFFTC-TR-79-21, F-15 APG-63 Radar, Hardware/Software Improvements
12. December 1979, F-15 AFDT&E TEWS Phase III, AD-TR-79-84
13. November 1980, AFFTC-TR-80-23, F-15C Flying Qualities, AFDT&E
14. March 1981, Tape 066 OFP Verification AD-TR-77-4 (ALR-56)
15. September 1981, AFFTC-TR-81-18, F-15 Limited Takeoff and Landing Evaluation
16. CIP Task 005, F-15/F-16 Flight Test (Engine)
17. August 1986, AEDC TSR-86-P17, Wind Tunnel Aerodynamic Separation Characteristics of MK-20 and GBU-12 Stores from the F-15 Aircraft
18. December 1985, AEDC TSR-85-P23, Wind Tunnel Separation Characteristics of F-15E Stores from Conformal Fuel Tanks
19. February 1986, AEDC TMR-85-P22, Analysis of Separation Trajectories of F-15E Stores from Conformal Fuel Tanks
20. August 1986, AEDC TSR-86-P13, Wind Tunnel Aerodynamic Separation Characteristics of AGM-65 Maverick Missiles from F-15E Aircraft

(U) Contractor Development Test and Evaluation (CDT&E) Reports

1. 9 November 1971, MDC A-1429, Static Test Results, Final Report
2. 6 March 1972, MDC A-1595 I 5 F 1-Scale Inlet/Engine Compatibility Test
3. 7 March 1972, MDC A-1601, ural Utilization Report
4. 16 March 1972, MDC A-1617, Miles III, F-15 Avionics Integration Test Status

5. 28 April 1972, MDC A-1688, Results of Fatigue/Static Test of F-15 Preproduction Design Verification (PDV-1) Wing Carry Through
6. 2 August 1972, MDC A-1865, Final Report Propulsion Subsystem Endurance (Pit 4 F100 PW100 Engine Test)
7. January 1973, MDC A-2104, F-15 Demonstration Milestone 10, Documentation Report - Initial Airborne Avionics Performance
8. 27 February 1973, MDC A-2198, VOL I-VIII, F-15 Fatigue Tests-FTA 1 for Fuselage and Cockpit Fatigue Test
9. 5 January 1979, MDC A-5736, Test Program, JFS Air Start Capability in USAF Airplanes, Flight Test Program, St. Louis MO
10. 25 July 1979, MDC A-6084, F-15C Final Flight Test Report
11. 9 November 1981, MDC A-7436, Version Description Document (Computer Program for F-15 Indicator Group) (PSDP Operational Flight Program)
12. 20 Aug 86, MDC-A-9891 Birdstrike Resistant Windshield Element Fatigue Test Final Report
13. 03 Apr 85, MDC-A9085 F-15E Windshield Strain Survey Birdstrike Tests
14. 21 May 85, MDC-A9128 Element Fatigue & Material Characterization Test on F-15E Wing Area

2. (U) Operational Test and Evaluation (OT&E): Initial Operational Test and Evaluation (IOT&E): The F-15 IOT&E was part of a combined IOT&E/Air Force and contractor Development Test and Evaluation (DT&E) conducted at Edwards AFB, CA, using data from contractor and Air Force DT&E sorties flown July 1972 through 30 June 1975. The IOT&E was USAF directed, Tactical Air Command conducted, and Air Force Test and Evaluation Center (AFTEC) monitored. The IOT&E provided estimates of system operational effectiveness and suitability in support of Defense Systems Acquisition Review Council (DSARC) decisions related to increased production rate. Specific test objectives addressed both air-to-air and air-to-ground mission roles. In the 2.5 year effort 4460 sorties were flown. The aircraft was found to have superior handling and flight characteristics in the air-to-air regime. Likewise the F-15 was shown to be an effective platform for air-to-ground ordnance delivery. The continual change of hardware and software throughout the test program precluded establishment of a reliability assessment data base. The immaturity of built-in test (BIT) and the absence of major test equipment items were limiting factors in the overall suitability evaluations.

(U) Follow-on Operational Test and Evaluation (FOT&E): The F-15 FOT&E was an independent test and evaluation managed by the AFTEC and conducted by the AFTEC test team at Luke AFB, AZ. The objectives of FOT&E were to verify the operational effectiveness and suitability, which included assessment of the logistics supportability, life cycle costs, and identification of desirable modifications or trade-offs for the production F-15 system. The FOT&E commenced in March 1975 and finished in July 1976 using a total of 1111 F-15 sorties and approximately 900 support sorties. Evaluation sorties were flown by AFTEC and Tactical Air Command pilots. Once again, the F-15 was found to be an excellent weapons system for air-to-air combat. Several deficiencies were noted, but the F-15 Program Office has since corrected them. Test estimates of reliability/maintainability indicated that the F-15A will be malfunction free on 20 percent of the sorties and generally have the capability to turn for a second mission 50 percent of the time. The manpower requirements necessary to support a 72 aircraft wing were estimated at approximately 1000 authorizations.

(U) In addition to the above testing, an IOT&E of the F-15 Tactical Electronic Warfare System (TEWS) was conducted by the US Air Force Tactical Air Warfare Center (USAF TAWC), Eglin AFB, FL. TEWS gives the fighter pilot an EW

capability far superior to that of previous electronic warfare (EW) systems. The resources of the Armament Development and Test Center, the Naval Weapons Center, and the 6512 Test Squadron, Air Force Systems Command were used during the test. The test was conducted simultaneously with Air Force and contractor Development Test and Evaluation (DT&E) from February 1974 through October 1976. The IOT&E, which was Air Force directed and Air Force Test and Evaluation Center monitored, was comprised of 325 sorties. Air Force personnel performed organizational level maintenance for the F-15 Tactical Electronic Warfare System (TEWS). However, intermediate and depot maintenance support was accomplished entirely by contractor engineers and technicians using interim special test equipment.

(U) An IOT&E of the Overload Warning System (OWS) was conducted by the US Air Force Tactical Fighter Weapons Center (USAFTFWC), Nellis AFB, NV. The OWS should reduce F-15 airframe damage resulting from flight overload situations as well as permitting more effective employment of the F-15. The OWS IOT&E report was released in March 1981. Production incorporation began with the FY 1980 buy, and the first aircraft was delivered in December 1981.

(U) The Air Force Operational Test and Evaluation Center (AFOTEC) participated in a combined DT&E/Operational Utility Evaluation (OUE) of the F-15 dual-role fighter (DRF) from August 1982 through April 1983 at Edwards AFB, CA. AFOTEC testing emphasized air-to-surface mission capabilities. Effectiveness data were collected on 49 dedicated OUE sorties. Suitability data were collected on 151 combined DT&E/OUE sorties. The prototype F-15 DRF demonstrated a significant improvement over the F-15 aircraft baseline in range and payload for all configurations flown. Performance and handling, in both air-to-surface and air-to-air combat operations, were equal to or better than the baseline when the conformal fuel tanks were empty. The F-15 DRF could be flown effectively at its maximum gross weights and configurations, but predictably, its maneuverability was somewhat degraded. Overall, the aircraft has improved air-to-surface operational capabilities while retaining its basic air superiority capability.

(U) The F-15 Multi-Staged Improvement Program (MSIP) Follow-on Operational Test and Evaluation (FOT&E) is being conducted by TAC at the USAF Tactical Air Warfare Center (USAFTAWC). The program is being conducted in three phases: Air to Air, Tactical Electronic Warfare System (TEWS) and Air to Ground. Phase 1 Air to Air testing began 2 September 1985 and was completed 28 March 1986. The FOT&E final report was published in August 1986. Phase 2 was cancelled in early 1987 due to redundancy with F-15 TEWS testing. Phase 3 Air-to-Ground testing is going to be transferred to the 57th Fighter Weapons Wing and will be combined with F-15 Operational Flight Program FOT&E; it will begin at an undetermined future date.

(U) F-15 TEWS testing is in the final stages of planning and will be conducted in four phases. Phase 1, ALR-56C IOT&E, will be conducted from January 1988 and May 1988. Phase 2, ALQ-135 Band 3 IOT&E, will be conducted between February 1988 and August 1988. Phase 3, ALR-56C/ALQ-135 Band 3 integration, will be conducted between August 1988 and February 1989. Phase 4, ALR-56C/ALQ-135 Band 3/ALE-45/ALQ-128 integration, will be conducted between February 1989 and July 1989.

(U) Combined DT&E/OT&E will be conducted on the F-15E. AFOTEC will conduct the OT&E which will occur primarily at Edwards AFB, CA. Deployments to Eglin AFB, FL; Holloman AFB, NM; and McChord AFB, WA are planned; their purpose will

be to encounter terrain and weather that are more representative of the planned theaters of operation and to conduct air-to-air missile firings. OT&E objectives have been fully integrated with DT&E objectives to shorten the schedule and reduce the cost. Data collected during DT&E missions should lower the number of dedicated OT&E sorties to 150. Test scenarios are being structured to accommodate the objectives of the combined test program and to answer the four critical operational issues:

(1) Will the F-15E be capable of night, under-weather air interdiction and offensive counter air in a combat environment?
(2) Will the F-15E retain the F-15C/D Multi-Staged Improvement Program's (MSIP) capability for the air-to-air role?
(3) Will the F-15E be sufficiently available to fulfill operational requirements?
(4) Will the F-15E weapon system be sufficiently reliable to perform its combat mission?

The Air Force Operational Test and Evaluation Center (AFOTEC) Test Team will include personnel from Tactical Air Command, Air Force Logistics Command, Air Training Command, and Military Airlift Command (Air Weather Service). The first increment of the AFOTEC Test Team completed all required prerequisite training and reported to Edwards AFB in June 1987. A second increment reported in October 1987. The final increment will report in March 1988. An IOT&E report will be published prior to Initial Operational Capability (IOC) based on testing through June 1989. Dedicated OT&E missions will be conducted using two production aircraft, operational crews, and USAF maintenance. The ability to do meaningful testing in a threat environment will be limited by the fact that the Tactical Electronic Warfare System will still be in development during this test. Lack of a full-up Mobile Electronic Test Set (METS) will make it difficult to estimate suitability values that depend on intermediate level maintenance.

(U) Operational Test and Evaluation (OT&E) Reports

1. F-15 Initial OT&E Final Report, January 1976 (U)
2. F-15A Follow On OT&E Final Report, August 1976 (U)
3. F-15 TEWS IOT&E Final Report, January 1977 (U)
4. F-15 Verification T&E in Europe, July 1977 (U)
5. F-15 Tactical Electronic Warning System, December 1979 (U)
6. F-15 Overload Warning System, March 1981 (U)
7. F-15 Improved Radar QOT&E Final Report, July 1981 (U)
8. F-15 DRF OUE Final Report, November 1983 (S)
9. F-15 MSIP Phase I, (FOT&E) August 1986 (S)

3. (U) System Characteristics: The F-15 is an advanced tactical fighter developed for the air superiority mission. It is a twin engine, single place, fixed swept wing airplane characterized by high thrust-to-weight and low wing loading for superior acceleration and maneuverability. The F-15 is equipped with a balanced mix of air-to-air weapons ranging from medium range all-weather missiles to rapid-fire 20mm cannon and provides an outstanding capability against the postulated enemy air threat.

Budget Activity: 4, Tactical Programs
Program Element: 27134F, F-15 Squadrons

| | DEVELOPMENT ESTIMATE | DEMONSTRATED PERFORMANCE |
|---|---|---|
| A. (U) Operational | | |
| 1. (U) Max Mach No @ Altitude (Sustained/Burst) | 2.3/2.5 | 2.3/2.5 |
| 2. (U) Max Mach No @ Sea Level (Sustained) | 1.2 | 1.16 |
| 3. (U) Design Maximum Load Factor (80% Internal Fuel), g | 7.33 | 7.33 |
| 4. Maximum Buffet-Free Maneuver g (0.8M, 30K ft), g | | |
| 5. Energy Maneuverability (Ps), fps | | |
| a. ( 0.9M, 30,000 ft, 5g, Mil Pwr | | |
| b. ( 0.6M, 10,000 ft, 5g, Max Pwr | | |
| c. ( 0.9M, 10,000 ft, 1g, Max Pwr | | |
| d. ( 0.9M, 10,000 ft, 5g, Max Pwr | | |
| e. ( 0.9M, 30,000 ft, 5g, Max Pwr | | |
| f. ( 0.9M, 35,000 ft, 5g, Max Pwr | | |
| B. (U) Technical | | |
| 1. Design Mission Takeoff Wt, lb | 40,000 | 41,491 |
| 2. Takeoff Wing Loading, lb/ft | 66 | 68 |
| 3. Uninstalled Thrust-to-Takeoff Weight Ratio | 1.17 | 1.15 |

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| Phase II Stores Separation Flight Test | Apr 1987 | May 1987 | |
| Digital FLT CTL Evaluation | 4Q FY87 | Sep 1987 | TAC F-15C/D Pilots |
| Phase II Seek Eagle WTT | Sep 1987 | Sep 1987 | |
| MSIP Radar Flight Test (APG-70 Hardware) | Through Sep 1987 | Sep 1987 | |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| F-15E DT&E/OT&E Flight Test | Jun 1989 | Ongoing Combined DT&E/OT&E |
| ALQ-135 QRC combined DT&E/OT&E Flight Test | Through Mar 1988 | Ongoing |
| MSIP/AMRAAM Investigation Flight Test | Through Dec 1988 | Ongoing |
| ALR-56C IOT&E | 2Q FY88 | USAFTAWC |
| ALQ-135 Band 3 IOT&E | 2Q FY88 | USAFTAWC |
| ALR-56C/ALQ-135 Band 3 Integration | 4Q FY88 | USAFTAWC |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207133F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: F-16 Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 53,651 | 25,401 | 26,461 | 92,637 | 1,470,600 |
| 2671 | F-16A-D | 53,651 | 25,401 | 26,461 | 92,637 | 1,470,600 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program satisfies the mission need for a high performance, multimission fighter capable of performing a broad spectrum of tactical air warfare tasks at an affordable cost. The F-16 is designed for high sortie rates with rapid turnaround, minimum manpower and logistics burden, and exceptional air combat maneuvering performance coupled with a potent air-to-surface weapons delivery capability. The F-16 is replacing aging F-4s in the active inventory as well as modernizing the Reserve Forces.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 54,872 | 36,486 | 23,640 | 92,637 | 1,481,300 |
| Aircraft Procurement | 2,951,908 | 2,885,168 | 3,461,667 | 18,039,800 | 46,047,300 |

EXPLANATION: (U) RDT&E - In FY 1987 $1.221 million was reduced from the Government Test and Support line to fund higher priority projects. In FY 1988 the Advanced IFF (MK XII interrogator) development was reduced $6 million and the Robust Countermeasures development effort of $5 million was cancelled to offset Congressional reductions. The FY 1989 request includes $2.846 million for government test and support of the Air Defense Fighter. The additional RDT&E funds to completion continue avionics enhancements and Seek Eagle verification requirements through FY 1994.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds | 2,917,700 | 2,788,700 | 3,705,166 | 18,039,800 | 46,185,400 |
| Quantities | 180 | 180 | 180 | 870 | 2729 |

5. (U) RELATED ACTIVITIES: The following program elements contain development efforts which are applicable to the F-16: PE 0604314F/0207163F, Advanced Medium Range Air-to-Air Missile; PE 0603249F, Night Attack Program; PE 0604249F, Night/Precision Attack (Low Altitude Navigation and Targeting Infrared System for Night); PE 0604725F, Aircraft Identification System (Combat Identification System); PE 0604201F, Aircraft Avionics Equipment Development; PE

PE #: 0207133F

0604218F, Engine Model Derivative Program; PE 0604737F, Airborne Self-Protection Jammer; PE 0604268F, Aircraft Engine Component Improvement Program; PE 0604233F, Alternate Fighter Engine; and PE 0603742F, Combat Identification Technology.

6. (U) WORK PERFORMED BY: The F-16 System Program Office of the Aeronautical Systems Division (ASD), Wright-Patterson Air Force Base, OH, has management responsibility for the F-16C/D program as well as residual development tasks identified for the F-16A/B program. The F-16 System Program Management Division of the Ogden Air Logistics Center, Materiel Management Directorate, Hill AFB, UT, has management responsibility for the F-16A/B program, with the exception of residual tasks retained by ASD under the Program Managememt Responsibility Transfer agreement. The major contractors are General Dynamics, Fort Worth, TX (F-16 airframe); Pratt & Whitney, East Hartford, CT and General Electric, Evandale, OH (engine); and Westinghouse, Baltimore, MD (radar). In addition to these, there are over 4,000 other subcontractors and suppliers in the United States. Major European manufacturers include Fabrique Nationale, Belgium (engine); SABCA/SONACA, Belgium (aft fuselage, wings and assembly); FOKKER, The Netherlands (center fuselage and assembly); DAF, The Netherlands (landing gear); Per Udsen, Denmark (pylons and vertical fin); Kongsberg Vapenfabrikk, Norway (inertial navigation set and fan drive module); and General Electric Corporation, England (head-up display).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2671, F-16A-D

A. (U) Project Description: This project has developed the F-16 aircraft from its origin in the Lightweight Fighter Prototype Program in the early 1970s to the fighter aircraft currently being produced and deployed in these tactical air forces: Tactical Air Command, United States Air Forces Europe, Pacific Air Forces, Air Force Reserve, Air National Guard, and the air forces of thirteen other countries around the world. Continued engineering flight test provides for the airframe, engine, aircraft subsystems and stores certification; a development effort also addresses increased F-16 capability to meet the quantitive and expanding qualitative threat. Efforts currently underway include radar improvements required for use of radar missiles and enhanced electronic counter-countermeasures, the integration of the Advanced Medium Range Air-to-Air missile (AMRAAM), development of an Automatic Terrain Avoidance (Auto TA) capability to be used in conjunction with the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system, and development of an F-16 combat identification capability for the employment of beyond visual range missiles.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 RDT&E funds were used for mission support, to continue support of follow-on test requirements for equipment upgrades and identified deficiencies, and to continue development of previously initiated efforts. Development continued on the All Environment Identification System, a Mark XII system with interrogator and transponder capability. This identification friend or foe capability is required to take full advantage of beyond visual range missile capability. Development and integration of an Operational Capability Upgrade (OCU) modification kit for Block 15 F-16A/Bs was completed. The OCU program adds expanded memory and increased

input/output capability to the embedded computers and a data link to the APG-66 radar to allow future growth in the capabilities of these aircraft. This upgrade allows employment of new weapons such as AMRAAM and will baseline a common aircraft configuration with our European partners. Development of the Auto TA system to complement the LANTIRN system was completed. Development continued on Shrike and HARM missile integration and testing of the electronic counter-counter measures (ECCM) capability which will enable the APG-68 radar to neutralize efforts to jam its operation.

(2) (U) FY 1988 Program: The FY 1988 RDT&E program is continuing the efforts described in FY 1987 for follow-on engineering, test support, and Seek Eagle certification to include the Shrike and HARM missiles, and mission support for the F-16 System Program Office. The All Environment Identification system will continue development work on a combined interrogator/transponder and multi-sensor integration that can synthesize identification information from a number of sensors. Development will also continue on the electronic counter-countermeasure capability for the APG-68 radar. Development is completed on several subsystems including the Low Altitude Navigation and Targeting Infrared for Night System, Global Positioning System, digital flight controls and the Advanced Medium Range Air-to-Air Missile (AMRAAM) and High Speed Antiradiation Missile (HARM)/Shrike. An advanced radar warning receiver and chaff and flare dispenser continue development for full incorporation in future F-16 aircraft.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 RDT&E Program continues the efforts of the Program Office and test organization to develop improved avionics to meet the evolving threat of the 1990s. This includes follow-on engineering support, test support, Seek Eagle certification and mission support of the F-16 Program Office. Government test support for the Air Defense Fighter is included in the FY 1989 program ($2.864 million). Effort to improve the beyond visual range identification capability of the All Environment Identification System through preplanned product improvement capabilities for the electronic countermeasure system is completed. Effort continues to integrate increased thrust engines through improved electronic engine controls.

(4) (U) Program to Completion: This is a continuing program. Funding for follow-on test and engineering, as well as program office mission support, will continue. Development effort will complete the advanced Mark XII Identification system. Avionics upgrade will continue throughout this period in order to meet the ever increasing threat in the 1990s. Finally, the radar electronic counter-countermeasure system will complete development and test.

C. (U) Major Milestones:

| | | Milestones | | Date |
|---|---|---|---|---|
| (1) | (U) | Source Selection and Award of Development Contract | | January 1975 |
| (2) | (U) | Defense Systems Acquisition Review Council (DSARC) II | | March 1975 |
| (3) | (U) | European Long Lead Funds Released | | June 1976 |
| (4) | (U) | Delivery First Full-Scale Development Aircraft | | December 1976 |
| (5) | (U) | DSARC IIIA (Long Lead Release) | | January 1977 |
| (6) | (U) | DSARC IIIB (Production) | | October 1977 |
| (7) | (U) | First Aircraft to Tactical Air Command | | January 1979 |
| (8) | (U) | First European Aircraft | | January 1979 |
| (9) | (U) | Initial Operational Capability | | October 1980 |
| (10) | (U) | Delivery of 651st Aircraft | | September 1983 |
| (11) | (U) | Initial Delivery of the F-16C | | July 1984 |
| (12) | (U) | Program Management Responsibility Transfer F-16A/B to AFLC | | October 1985 |
| (13) | (U) | Delivery of Last F-16 | * (May 1997) | May 1998 |

* Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Change:

(12) (U) Delivery has been extended one year with the addition of aircraft procurement in FY 1995.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

As of: January 1988

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): General Dynamics is the prime contractor for airframe and support equipment development and Pratt & Whitney is responsible for continued development of the F100 engine. The General Electric F110 engine was introduced in production in 1986. Most of the major development testing on the basic aircraft, subsystems, and support equipment have been completed. Performance and stability and control testing indicate that the aircraft can meet design specifications and be employed effectively throughout the flight envelope. The F-16 has demonstrated that it can carry and employ a varied mix of weapons including air-to-air ordnance, air-to-surface guided missiles, conventional bombs, and nuclear weapons. The F-16 radar meets basic specifications and can be used effectively to deliver air-to-air and air-to-ground weapons. Ground testing results indicate an airframe life of at least 8,000 hours. As would be expected in any development program, there have been changes required to correct problems identified during the test program. Fixes have been designed, tested, and incorporated into the production aircraft. The last of the development aircraft was delivered in August 1978 and the first F-16 unit was activated at Hill Air Force Base, UT, in January 1979. All weather testing in desert and tropical climates is completed. Alaskan cold weather tests and an evaluation in European weather conditions were completed in early 1979. Testing to evaluate engine inlet icing problems was initiated in 1979 and verified the value of the heated inlet strut and engine anti-ice improvements.

(U) Future flight tests will include certification of additional weapons, continued systems integration tests, and evaluation of fixes for previously identified deficiencies. The major test activity in follow-on development will be evaluation of the enhancement of aircraft systems necessitated by threat evolution. Reliability and Maintainability (R&M) testing has been an integral part of the development effort and the F-16 current experience indicates it has met R&M goals established at program approval.

(U) There were originally eight full scale development aircraft and a decision was made in 1980 to authorize 11 production aircraft to upgrade the F-16 test fleet. Of the original eight aircraft, three have been decommissioned, one has been leased to General Dynamics for the F-16/J79 program, one is assigned to the Advanced Fighter Technology Integration program, two have been modified under the General Dynamics Independent Research and Development program to the F-16XL configuration, and one is still being used at the Air Force Flight Test Center for follow-on testing.

(U) The two F-16XL aircraft were at Edwards AFB through FY 1985 for the flight evaluation of the F110 engine, a large modular inlet duct, leading edge flaps, and an advanced flight control system. Of the 21 production aircraft in the test fleet, ten are assigned to Eglin AFB for Advanced Medium Range Air-to-Air Missile, SEEK EAGLE, and other weapons development testing. Eleven are assigned to Edwards AFB for follow-on testing and Multinational Staged Improvement Program integration to include the APG-68 radar and F110 engine. One production aircraft was attrited in a Class A accident. This test force was augmented with up to eight additional operational aircraft which are being used to support Low Altitude Navigation and Targeting Infrared for Night, Global Positioning System, Airborne Self-Protection Jammer, and ALR-74 DT&E and initial operational test and evaluation efforts.

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

(U) Over the next year the major test efforts will be in support of the F110 engine, APG-68 radar improvements and integration of the other Multinational Staged Improvement Program avionics (Block 30, February 1987) in addition to the normal follow-on testing and weapons certification. Testing in support of the growth subsystems being added to the F-16 includes the Advanced Medium Range Air-to-Air Missile, Low Altitude Navigation and Targeting Infrared for Night, Airborne Self-Protection Jammer, and Global Positioning System. These tests will continue to grow as the subsystems near their production effectivity.

2. (U) Operational Test and Evaluation (OT&E): The F-16A/B initial operational test and evaluation (IOT&E) was conducted in conjunction with development test and evaluation (DT&E) from December 1976 to October 1977. The IOT&E results reported in the Air Combat Fighter IOT&E Final Report, January 1978, US Government distribution, supported a production recommendation to the Defense Systems Acquisition Review Council IIIB. Follow-on operational test and evaluation (FOT&E), Phase I, was completed in January 1979 and reported in the F-16 (A/B) FOT&E Final Report, Phase I, June 1979, US Government distribution.

(U) The purpose of the OT&E was to evaluate the operational suitability and effectiveness of the F-16A/B weapon system. The radar/head-up display/fire-control system interface was evaluated in air-to-air missions against projected simulated threat aircraft and in air-to-surface attack missions. Air-to-air weapons such as the AIM-9 and M61 gun were fired at realistic maneuvering targets. Day and night evaluation of the F-16A/B air refueling capability was accomplished. The F-16A/B's performance and handling characteristics were qualitatively and quantitatively evaluated while performing basic fighter maneuvers and air combat maneuvers against current and projected simulated threat aircraft. The electronic countermeasures capability and electromagnetic interference susceptibility of the F-16A/B were evaluated. In addition, the operational suitability evaluation included the following: reliability and maintainability to include maintenance support factors, potential maintenance safety hazards, and determination of training requirements and operating and support costs.

(U) This F-16A/B combined DT&E/IOT&E was conducted primarily at Edwards AFB, California. Other test sites were Nellis AFB, Nevada; China Lake NWC, California; Alaska; El Centro NAS, California; Yuma MCAS, Arizona; Panama, Canal Zone; and Eglin AFB, Florida. An Air Force Operational Test and Evaluation Center (AFOTEC) test team composed of personnel from AFOTEC, Tactical Air Command (TAC), Air Force Logistics Command, and Air Training Command conducted the OT&E portion of the combined tests. Additionally, a combined Air Force Systems Command/AFOTEC European test and evaluation with three aircraft was conducted from February to May 1979. Test sites included Bodo AB, Norway; Skrydstrup AB, Denmark; Hahn AB, Germany; and Alconbury AB, United Kingdom. Test resources were incrementally increased to a total of 11 aircraft of which eight were preproduction aircraft and three were production.

(U) FOT&E Phase II was conducted at Hill AFB, Utah, and in Europe from January 1979 through December 1980. TAC was responsible for operational effectiveness, and AFOTEC further evaluated operational suitability. The AFOTEC assessment included reliability and maintainability data generated by all F-16A/B aircraft assigned to Hill AFB, Utah.

(U) F-16A/B operational suitability, as reported in the F-16 Operational Suitability Test and Evaluation, Phase II Final Report, October 1980 was overall satisfactory during part I multinational operational test and evaluation

(MOT&E). Weapon system reliability was highly satisfactory with cumulative mean time between maintenance for inherent failures and total corrective mean time between maintenance at 1.42 and .47 hours, respectively. Mission reliability continued to exceed the goal of 90 percent through the last 8 months of the evaluation. Maintainability was satisfactory, although improvement was needed in certain areas. Cumulative maintenance man-hours per flying hour (MMH/FH) (35) steadily declined throughout the OT&E to an end value of 29 MMH/FH. However, concerns existed about combat quickturn safety, limited onboard avionics self-test/built-in test (ST/BIT) capability, and immaturity of the avionics intermediate shop/automatic test equipment. By the end of the evaluation, various program efforts had been established to address these concerns. Availability was highly satisfactory with the mission capable rate stabilizing at 70 to 74 percent. Logistic supportability was satisfactory; however, adequacy of funding levels for war readiness spares kits (WRSK), F-100 engine support, and weapon system spare parts will continue to be critical to F-16A/B supportability in the outyears.

(U) F-16A/B follow-on operational test and evaluation (FOT&E)/tactics development and evaluation (TD&E), Phase II, commenced during January 1979 at Hill AFB, Utah. This FOT&E/TD&E was conducted jointly by the Air Forces of Belgium, Denmark, the Netherlands, Norway, and the United States. FOT&E/TD&E Phase II, designated the multinational operational test and evaluation (MOT&E) consisted of two parts. Part I, conducted in the United States (Hill AFB) from January 1979 through June 1980, used test facilities and ranges at the following locations: Dugway/Wendover, Utah; White Sands Missile Range, New Mexico; and the Nellis Range complex in Nevada. Part II was conducted in Europe from locations within the countries of the European Participating Air Forces (EPAF) between July and December 1980. In both parts of the MOT&E program, a mix of USAF and EPAF production aircraft was used, with a maximum of ten F-16A/Bs used as test assets during Part I and seven F-16s during Part II. Tactical Air Command (TAC) was responsible for the operational effectiveness and tactics development objectives; the Air Force Operational Test and Evaluation Center (AFOTEC) was responsible for the suitability assessment.

(U) The purpose of the MOT&E was to refine estimates of F-16A/B operational effectiveness, assist in evaluation of configuration changes, develop tactics and operating concepts for F-16A/B employment, and assess the operational suitability of the aircraft. The TAC F-16 MOT&E Final Report and Tactics Manual were released in May 1981.

(U) AFOTEC flew 467 front seat and 98 back seat sorties during initial and follow-on test and evaluation (IOT&E/FOT&E). This included six months of testing on two near production-configured full-scale development (FSD) aircraft and seven aircraft-months on the first three production aircraft. Operational test and evaluation included beyond visual range missions with F-4 and T-38 aircraft; operational comparisons, basic flight maneuvering and air combat maneuvering with F-4E, F-5, A-37, and T-38 aircraft; night and day air-to-surface bombing and strafe; air-to-air gunnery against towed targets; and AIM-9M/L firings against BQM-34, PQM-102, and QH-50 drones. Overall weapons system performance and reliability and maintainability estimates were rated satisfactory.

(U) Reliability and maintainability estimates indicated an overall satisfactory rating. The IOT&E/FOT&E assessments for late FSD and production aircraft projected satisfactory mean time between maintenance (MTBM) and maintenance man-hours per flying hour (MMH/FH) for the mature F-16A/B. Average F-16A/B MTBM (for inherent failures) of 0.87

hour compared very favorably with the F-4 and A-7D mature average of 1.0 at the end of Full Scale Development. F-16A/B maintenance man-hours per flying hour (MMH/FH) of 35.7 nearly equaled the mature F-4's 35. Corrective actions to fix major discrepancies affecting reliability and maintainability goals; i.e., chafing and routing of aircraft wiring, high rate of fuel leaks, and excessive fuel venting due to heat expansion were incorporated and were evaluated as satisfactory during ET&E. Damage or loss in flight of nonmetallic panels is no longer a problem because of replacement with metal panels. Concerns remaining at the end of IOT&E/FOT&E included high could-not-duplicate rates for self-test/built-in test equipment; high repair times for environmental control, hydraulic/pneumatic, auxiliary power, flight control, and fuel systems; and supportability of the hydrazine emergency power unit. Further evaluation of these areas continued during MOT&E.

(U) MOT&E phase II (European) suitability results were highly satisfactory. Weapon system reliability was exceptionally high with a mean time between maintenance (MTBM) of 2.22 hours for inherent failures. Mission reliability was excellent at 94 percent. Aircraft availability was slightly better than that of phase I with an overall mission capable rate of 79 percent. The MMH/FH value of 3.76 could not be compared to USAF data because of substantial documentation differences between the USAF and the European Participating Air Forces (EPAF). With the exception of potential long-term impacts from aircraft corrosion caused by industrial pollution, F-16A/B operations in Europe did not produce significantly different conclusions from those drawn during phase I MOT&E.

(U) A combined Air Force Systems Command, Air Force Operational Test and Evaluation Center ET&E with three aircraft was conducted from February to May 1979. Test sites included Bodo AB, Norway; Skrydstrup AB, Denmark; Hahn AB, Germany; and Alconbury AB, United Kingdom. During the ET&E, the F-16A/B was used in a wide variety of realistic operational mission scenarios to provide an early assessment of its effectiveness and suitability when operated in its intended environment. One hundred forty-two sorties were flown for an effective sortie rate of 0.78 which was well above the planned rate of 0.50. As reported in the European Test and Evaluation Final Report Addendum F-16 FOT&E Phase I, November 1978, overall F-16A/B performance was highly satisfactory. Taxi, takeoff, and landing on icy surfaces presented no major problems. Operational effectiveness deficiencies noted during ET&E included the following:

(U) Engine icing during ground operations: At near freezing temperature, induction icing occurred when the engine ingested standing water. Although this creates the potential for engine damage, none was observed during the test. Pilot manual selection of anti-ice was incorporated while a heated intake strut and additional heat through thirteenth-stage compressor inlet guide vanes were incorporated in late CY 1981.

(U) Inadequate lighting for night air refueling: Satisfactory solutions were identified with incorporation completed in late CY 1981.

(U) Fuel venting during air refueling: The problem was attributed to fuel distribution. A redesigned fuel shuttle valve (Engineering Change Proposal 478) has been installed on all F-16 aircraft effective August 1985. The F-16 program office continues to track field reports for any recurrence of fuel distribution problems.

(U) False radar targets: Caused by radar side lobes reflecting off the surface and a frequency instability in the main beam. Solutions have been tested, approved, and incorporated.

(U) A software fix to track targets through the 55-knot radar notch has been incorporated in Block 15B.

(U) Boresighting procedures have been improved, corrected canopy distortion algorithms and slant range corrections have been installed in the fire-control computer, and updated weapons separation effects have been included in the stores management system. Testing has demonstrated that these solutions meet specifications, and fixes are in the field.

(U) Fire control/navigation panel (FCNP) difficult to operate by pilot: Fixes have been tested, approved, and incorporated in production.

(U) F-16A/B reliability and maintainability during FT&E was satisfactory to excellent. Mean time between maintenance (inherent) was 1.39 hours, and maintenance man-hours per flying hour (MMH/FH) was 17.3. Aircraft flyable rate was excellent at 82 percent. This compares with the end FOT&E rate of 54 percent. Problems included low reliability of the radar digital signal processor and low-power radio frequency units and a high rate of could-not-duplicate avionics and electrical malfunction indications. A hydrazine spill resulted in recommendations for several procedural, hardware, and protective equipment improvements. Operations from five different NATO shelter types were satisfactory.

(U) The Air Force Operational Test and Evaluation Center (AFOTEC) participated in a combined DT&E/operational utility evaluation (OUE) of the F-16 dual role fighter from July 1982 through April 1983 at Edwards AFB, California. This F-16 is a significantly modified F-16 featuring a cranked arrow wing and slightly stretched fuselage. The modifications provide more avionics space, more fuel capacity, and semiconformal carriage of weapons. The purpose of AFOTEC's OUE was to provide performance data for comparison with the F-16A/B to support a derivative fighter full-scale development decision. The effectiveness evaluation concentrated on aerodynamic handling qualities, range/payload capabilities, and weapons delivery. AFOTEC testing emphasized air-to-surface mission capabilities. Effectiveness data were collected on 36 dedicated OUE sorties. Suitability data were collected on approximately 326 combined DT&E/OUE sorties.

(U) The F-16 dual role fighter demonstrated an improved air-to-surface operational capability while retaining its basic air-to-air capability. This prototype demonstrated improvements over the F-16A in maximum air-to-surface combat radius, performance, and handling qualities. It also exhibited an improved capability in theater air defense radius and loiter time. While similar to the F-16A in tactical ferry range, routine operations, and operational suitability, the dual role fighter performance was inferior to the F-16A in 1 versus 1 within-visual-range air combat maneuvering.

(U) AFOTEC participated in F-16C/D combined DT&E/IOT&E from January 1983 through December 1984. In addition, AFOTEC conducted independent F-16C/D IOT&E from January to April 1985. This DT&E/IOT&E was to evaluate F-16 enhancements resulting from the F-16 multinational staged improvement program (MSIP). The MSIP consists of phased improvements in F-16 air-to-air and air-to-surface mission capabilities by incorporating new developments in weapons and sensors. Basic changes in the F-16C/D include an improved radar (AN/APG-68), improved cockpit displays, wide-angle head-up display, increased computer speed and capacity, and provisions for future incorporation of Advanced Medium Range Air-to-Air Missile, Low Altitude Navigation and Targeting Infrared for Night, Airborne Self Protection Jammer, Global Positioning System, and the Advanced Radar Warning Receiver.

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

(U) Air Force Operational Test and Evaluation Center (AFOTEC) conducted the independent F-16C/D IOT&E using two production F-16Cs. Test missions were flown from Edwards AFB, California, and Nellis AFB, Nevada. Test aircraft were maintained by Air Force Systems Command personnel. The AFOTEC test team consisted of personnel from AFOTEC, Tactical Air Command (TAC), Air Training Command, and Air Force Logistics Command. The following operational effectiveness deficiencies were noted during the F-16C/D IOT&E:

Air-to-air operations were rated marginal. F-16C/D radar detection performance was better than F-16A/B performance but fell short of TAC requirements. [redacted]

Air-to-surface operations were satisfactory. Weapon delivery accuracy was better than requirements for all events except radar laydown. [redacted] These changes will be considered for retrofit, subject to funding constraints.

(U) Radar performance has been improved by software updates, Block 5A and 5A updates, incorporated in FY 1986. Performance will be further improved by production incorporation and retrofit of Block 6A followed by Block 6B update beginning in February 1987. All software changes are validated by ongoing DT&E and OT&E.

(U) F-16C/D reliability and maintainability were marginal primarily due to excessive failures of avionics, particularly the AN/APG-68 radar, the standard Inertial Navigation System, the Head up Display and tires. Reliability improvements resulting from qualification and production tests combined with spares and personnel management actions have allowed reliability and maintainability requirements to be met in early 1987. Two high priority programs, Falcon C and Falcon 50, have been implemented by the F-16 System Program Office (SPO) to improve F-16C/D system reliability and maintainability. The Falcon C program continually assesses significant field-reported problems and assigns teams to resolve them. Progress and results are reviewed at least monthly by the SPO Director. Falcon 50 is attacking unit repair turnaround times with its goal being a 50 percent reduction in current turnaround times. These programs, coupled with improvements resulting from qualification and production reliability testing since IOT&E, have resulted in the F-16C/D fully meeting or exceeding its reliability & maintainability system maturity.

**Budget Activity:** 4, Tactical Programs
**Program Element:** 27133F, F-16 Squadrons

The Tactical Fighter Weapcns Center conducted a follow-on operational test and evaluation of the F-16C with the Block 25B Operational Flight Program (OFP) from July 1985 to February 1986. The test team flew 385 sorties including deployments from Luke AFB, AZ to Nellis AFB, NV for live ordnance and special weapons testing. The overall operational effectiveness of Block 25 was satisfactory.

The 57th Fighter Weapons Wing flew 526 sorties between February and September 1986 to evaluate F-16 C/D Block 30 OFP development. Sorties were flown from Luke AFB, AZ, with deployments to Nellis AFB, NV and Edwards AFB, CA.

(U) OT&E documents:

(1) F-16 A/B IOT&E Final Report, January 1978.
(2) F-16 A/B FOT&E Final Report, June 1979.
(3) F-16 A/B MOT&E Final Report and Tactics Manual, May 1981.
(4) F-16 DRF OUE Final Report, November 1983.
(5) F-16 C/D IOT&E Final Report, June 1985.
(6) F-16 C MSIP FOT&E Report, Block 25B, July 1986
(7) F-16 C MSIP FOT&E Report, Block 30, December 1986.
(8) F-16 C/D TEMP in coordination

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

3. (U) Systems Characteristics: (F-16A, Block 10)

(U) Technical Information:

| | |
|---|---|
| (U) Length (ft) | 49.5 |
| (U) Wing Span (w/missiles) (ft) | 32.8 |
| (U) Operating Weight (empty) (lbs) | 16,205 |
| (U) Internal Fuel (lbs) | 6,972 |
| (U) Current Max Takeoff Gross Weight (lbs) | 35,400 |
| (U) Max Payload w/Full Internal Fuel (lbs) | 12,223 |
| (U) Engine Thrust (lbs) Installed SL Static | 19,530 (F100-PW-200) |

(U) Performance Thresholds: (F-16 Development Concept Paper)

| | Threshold | Demonstrated |
|---|---|---|
| (U) Radius - Air Superiority Mission (NM) | 600 | 655 |
| (U) Radius - Air-to-Surface Mission (NM) | 550 | 666 |
| (U) Sustained Turn Rates | | |
| (U) 1.2 Mach/30,000 ft (°/sec) | 6.5 | 6.4 |
| (U) 1.2 Mach/30,000 ft (G) | 4.3 | 4.3 |
| (U) 0.9 Mach/30,000 ft (°/sec) | 8.7 | 8.1 |
| (U) 0.9 Mach/30,000 ft (G) | 4.3 | 4.1 |
| (U) Acceleration Time | | |
| (U) 0.9-1.6 Mach/30,000 ft (sec) | 70 | 70 |
| (U) Max Controllable G | | |
| (U) 0.8 Mach/40,000 ft (G) | 4.3 | 4.1 |
| (U) Ferry Range (NM) | 2,200 | 2,085 |

(U) Other Characteristics:

| | | |
|---|---|---|
| (U) Takeoff Distance (Air-to-Air Mission) (ft) | N/A | 2,500 |
| (U) Landing Distance (ft) (estimated, dry concrete) | N/A | 2,650 |
| (U) Mission Capability (%) | 90 | 88.4 |
| (U) Mean Flight Time Between Failure (hrs) | 2.90 | 3.6 |
| (U) Radar Detection Range, 2 sq meter Target (look up/look down) (Current APG-66) | 24/18 | |

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

4. (U) Systems Characteristics (F-16C):

| | Block 30 |
|---|---|
| **(U) Technical Information:** | |
| (U) Length (ft) | 49.5 |
| (U) Wing Span (w/missiles) (ft) | 32.8 |
| (U) Operating Weight (empty) (lbs) | 18,679 |
| (U) Internal Fuel (lbs) | 6,972 |
| (U) Current Max Takeoff Gross Weight (lbs) | 37,500 |
| (U) Max Payload w/Full Internal Fuel (lbs) | 11,849 |
| (U) Engine | F110-GE-100 |
| (U) SL Static Installed Thrust (lbs) | 20,080 |
| **(U) Performance Estimates:** | |
| (U) Radius - Air Superiority Mission (NM) | 532 |
| (U) Radius - Air-to-Surface Mission (NM) | 474 |
| (U) Sustained Turn Rates | |
| (U) 1.2 Mach/30,000 ft (°/sec) | 5.9 |
| (U) 1.2 Mach/30,000 ft (G) | 3.9 |
| (U) 0.9 Mach/30,000 ft (°/sec) | 7.3 |
| (U) 0.9 Mach/30,000 ft (G) | 3.7 |
| (U) Acceleration Time | |
| (U) 0.9-1.6 Mach/30,000 ft (sec) | 59 |
| (U) Instantaneous Turn Rates, .8M/40,000 ft (°/sec) | 12.3 |
| (U) 0.8 Mach/40,000 ft (G) | 4.6 |
| (U) Ferry Range (NM) | 1,888 |
| **(U) Other Characteristics:** | |
| (U) Takeoff Distance (Air-to-Air Mission) (ft) | 1,900 |
| (U) Landing Distance (ft) (estimated) | 2,950 |
| (U) Mission Capability (%) | 91.5 |
| (U) Mean Flight Time Between Failure (hrs) | 4.93 |

5. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| F-16A/B Improvements | Continuing | Dec 76 to present | Continued testing for weapons certification and F-16A/B model improvements/correction of deficiencies for both airframe and engine hardware/Operational Capabilities Upgrade; ongoing at Edwards AFB and Eglin AFB. |
| F-16C/D (MSIP) DT&E | Continuing | Nov 82 to present | Structural, performance and avionics testing related to MSIP III (Block 30/30B) aircraft and F110 engine development ongoing at Edwards AFB. |
| F-16C/D FOT&E | Continuing | Jun 85 to present | |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| F-16A/B Improvements | Continuing | Continued F-16 testing related to system enhancements and Operational Capabilities Upgrade is scheduled. |
| F-16C/D (MSIP) | Continuing | MSIP III (Block 30/30B) integration testing ongoing at Edwards AFB. |
| F-16C/D MSIP Stage III (AMRAAM, ASPJ, LANTIRN, GPS, ALR-74) IOT&E | Jun 86 to Oct 89 | Limited IOT&E planned through Block 30B (February 1987) with major test effort planned for the Block 40 (December 1988) aircraft. Each major subsystem incorporation date will depend on its development schedule. |
| F-16C/D FOT&E | Continuing | Tactical Air Command testing planned through September 1992. |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207136F
DOD Mission Area: 224 - Defense Suppression

Title: F-4G Wild Weasel Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 25,812 | 15,739 | 21,287 | Continuing | N/A |
| 327B | F-4G Wild Weasel Squadrons | 25,812 | 15,739 | 21,287 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The F-4G Wild Weasel is the only operational destructive defense suppression weapon system in the Air Force inventory. This system is specifically designed to automatically detect, identify, locate, engage, and destroy hostile radars. F-4G armaments consist of anti-radiation missiles, stand-off guided munitions, and conventional F-4 weapons. The F-4G can be employed in the counter-air role as an escort for the penetration strike force, as an independent hunter-killer force, or as a standoff defense suppression force. The original requirement for a Wild Weasel aircraft was validated in FY 1968. The F-4G was developed and produced in response to this requirement. Initial Operational Capability was achieved on 1 April 1979.

The APR-38 Performance Update Program for the F-4G Wild Weasel responds to this requirement.

The requirement for a Follow-on Wild Weasel weapon system, Statement of Operation Need TAF 305-86, was validated on 4 November 1987.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 35,333 | 17,762 | 17,001 | Continuing | N/A |
| Aircraft Procurement | 0 | 0 | 0 | 614,350 | 614,350 |

EXPLANATION: (U) The FY 1987 RDT&E funding difference is due to a congressional undistributed funding reduction and Air Force reprogramming actions. The changes in FY88 and FY89 are due to the restructuring of the Phase II development program caused by system technical design problems. These development problems, plus a restructured

flight test program (based on Phase I testing experience) collectively delayed the program by approximately 24 months. The change in the production funding profile reflects the slips in the development program. The increase in estimated total cost is due to a more complete estimate of production and installation costs done in FY 87, and inflation adjustments due to the later deliveries. These production estimates include both the Phase I and II procurements; all initial spares and modification of the four simulators. The spares and simulators, and Phase I kit buys for 18 F-4Es being converted to F-4Cs in FY 1988 were previously reported in other budget lines. Additional aircraft procurement funds for other F-4 modifications are not shown. Total quantity has changed because production of initial spares and support equipment for both Phase I and II, as well as the Phase I kits for F-4E to F-4G conversions, are included in this summary. Because the Phase I and II productions occur in different years, airframe attrition causes the quantities to differ.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Air Force advanced and engineering development program elements (PE 0603743F - Electronic Warfare Technology, PE 0604738F - Protective Systems, PE 0604739F - Tactical Protective Systems) developed the generic electronic combat technologies necessary to counter the advanced threat radars. The Imaging Infrared Maverick - PE 0207313F and the High Speed Anti-Radiation Missile - PE 0207162F are both being interfaced with the F-4G. A new Navigation Weapon Delivery System (NWDS) is being installed by Air Force Logistics Command as a Class IV modification and will interface with the APR-38 Attack/Warning Receiver. The above programs are responsible for developing and funding required interfaces for the F-4G/APR-38 system; however, this program element will ensure overall system capability integration. Modification of the F-4G with performance updates developed in this program will begin in FY 1988.

6. (U) WORK PERFORMED BY: McDonnell Douglas, St Louis, MO, is the primary contractor for the F-4G Wild Weasel Performance Upgrade Program (PUP). Subcontractors for the PUP are Sperry Univac, Minneapolis, MN; E-Systems, Garland, TX; and Micro Phase, Long Island, NY. Texas Instruments, Dallas, TX, builds the Memory Loader Verifier to upload and download the software into the APR-38. Singer-Link, Binghamton, NY, built, and still updates the F-4G simulator. Ogden Air Logistics Center, UT, is responsible for the management of F-4G enhancement programs. Air Force Systems Command, Andrews AFB, MD; Air Force Operational Test and Evaluation Center, Kirtland AFB, NM; and Tactical Air Command, Langley AFB, VA, are jointly responsible for testing of the F-4G. Air Force Systems Command is responsible for the subsystem and interface development of F-4G/APR-38 enhancements.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 327B, F-4G Wild Weasel Squadrons

A. Project Description: The APR-38 radar warning and attack system is the backbone of the F-4G Wild Weasel.

The update will also enhance the F-4G's ability to employ the High Speed Anti-Radiation Missile (HARM). All up dates will also be incorporated into the flight simulators.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Phase I IOT&E was completed. The new computer developed in Phase I is in production. Phase II efforts continue on receiver/processor integration and support equipment modification. The first Phase II FSD reciever prototype was delivered Mar 87. Fabrication of seven additional pre-product n units continued. Other Phase II-related tasks include: low frequency synthesizer delivery and completion of its airworthiness environmental, and reliability qualification; completion of final system software design reviews; and the start of flight test aircraft modification. A Follow-On Wild Weasel (F-WW) concept evaluation/trade off analysis study was completed. This study looked at the capabilities that will be required in the future to do the Suppression of Enemy Air Defense (SEAD) mission, evaluate alternatives, and examine potential airframes for the F-WW role.

(2) (U) FY 1988 Program: Production deliveries of the Phase I computer and associated aircraft installations begin. Development of Phase I depot support equipment begins. Phase II tasks include the fabrication and delivery of additional pre-production units and their acceptance testing; continuation of hardware/software integration; and deliver and acceptance of the electromagnetic environmental simulator (EES) at Warner-Robing Air Logistics Center. Phase II airworthiness testing will also begin. Phase II technical design problems, identified in FY87, are to be resolved in FY88. Initiate studies to examine receiver technology requirements and their availability for F-WW.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The remainder of the FSD pre-production Phase II units will be delivered. Phase II airworthiness qualification will be completed. Environmental qualification will be done, and reliability qualification testing will begin. Phase II of the Performance Update Program (PUP) will enter flight testing (Development Test and Evaluation and Initial Operational Test and Evaluation). Phase II depot support equipment development will begin. The RDT&E estimate is considered a Category II mature estimate. Phase II production costs are considered as Category IV planning estimates and are based on sole source procurement from the prime RDT&E contractor. The last full cost estimate review was accomplished December 1986. Initiate studies to identify and minimize F-WW weapon system integration high risk areas.

(4) (U) Program to Completion: Program consists of procurement and installation of the receiver/processor an other components in Phase II. Full Operational Capability (FOC) for Phase II will terminate the current PUP effort. However, this is a continuing program. Future R&D efforts and/or modification programs for the F-4G will be funded through this program element as required to maintain its viability for Defense Suppression.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) PUP Contract Award | | October 1982 |
| (2) (U) Phase I Efforts Initiated | | October 1982 |
| (3) (U) Phase II Efforts Initiated | | March 1983 |
| (4) (U) Phase I Production Contract Award | | July 1986 |
| (5) (U) Phase II Flight Test Start | *(December 1987) | January 1989 |
| (6) (U) Phase I IOC | | July 1988 |
| (7) (U) Phase II IOC | *(January 1991) | Sep 1992 |

*Date presented in FY 1988/1989 Descriptive Summary

(U) Explanation of Milestone Changes

(5) (U) Phase II flight tests slipped due to delay in deliveries of FSD pre-production systems by E-Systems. Technical design problems identified in the Phase II receiver during laboratory testing caused the delivery slips.

(7) (U) The aforementioned development problems delayed production contract award and IOC.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207215F  
DOD Mission Area: 327 - TIARA for Tactical Air Warfare  
Title: TR-1 Squadrons  
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 20,453 | 69,728 | 102,208 | Continuing | N/A |
| 3314 | TR-1 | 20,453 | 69,728 | 102,208 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The TR-1 Tactical Reconnaissance System provides the United States and allied forces in the NATO Central Region with near-real-time battlefield surveillance using the Advanced Synthetic Aperture Radar System (ASARS-2) imaging radar carried aboard the TR-1 aircraft. This sensor information is exploited in the TR-1 ground station located at the This program replaces the unprotected above ground prototype TR-1 ground station with a fully protected below ground, bunkered ground station. This ground station will be as survivable as the command structure it will support. The TR-1 program develops nonsensor related segments of the ground station and integrates the sensor exploitation segments into the ground station. These nonsensor segments of the ground station provide mission planning and control, communications, and maintenance support. They also provide the means to coordinate the activities of the various sensor exploitation segments to form an integral battlefield surveillance system.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 20,454 | 74,923 | 102,307 | Continuing | N/A |
| Other Procurement | 61 | 6,450 | 8,805 | 75,653 | 103,928 |

EXPLANATION: (U) FY 1988 Congressional cut of $4,923 and a recosting reduction of $272 in TR-1 R&D funding will delay software development by two months. This delay will cause a corresponding two month reduction in stateside integration and increased program risk. A FY 1988 Congressional cut of $5,000 in Other Procurement will cause a two year delay in the purchase of ASARS Processor support equipment. Contract Maintenance Support will have to be extended two years with corresponding increase in support costs and delay in full organic maintenance capability.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement | | | | | |
| Funds | 5,061 | 0 | 0 | Continuing | N/A |
| Quantities* | | | | | |

Program Element: 0207215F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: TR-1 Squadrons
Budget Activity: 4 - Tactical Programs

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Military Construction: Funds | 7,630 | 0 | 3,850 | 22,213 | 53,068 |

*(U) Procurement for the second TR-1 Ground Station (TRIGS)processor begins in FY 1992.

5. (U) RELATED ACTIVITIES: The Side Looking Airborne Radar (SLAR) Program Element 0604756F, Project 2037, SLAR Sensors and Project 2451, SLAR Exploitation, funds development of the airborne radar and ground processing equipment used in the TR-1 aircraft and TR-1 ground station, respectively.

6. (U) WORK PERFORMED BY: This program is managed by Aeronautical Systems Division, Wright-Patterson AFB, OH. The effort is on contract through a series of Critical Design Reviews, scheduled for January through June 1988, with Ford Aerospace, Palo Alto, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3314, TR-1.

A. Project Description: This project develops portions of the TR-1 ground station that are sensor independent. These include the mission control capability, communications element and maintenance support facility. These functions provide crucial mission planning, sensor tasking, sensor control, communications to tactical commanders, and maintenance support to the[ ]Advanced Synthetic Aperture Radar System (ASARS-2) radar processing and exploitation segments of TRIGS. This project also funds the procurement of the ASARS-2 Processing Segment developed in Program Element 0604756F.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Highly successful system Preliminary Design Reviews were held in April and May 1987. Completed efforts include mission planning, control, tasking, communications and logistics support development, facility design and subsystem and system level test planning. System architecture was finalized and preliminary hardware and software design was completed. Changes required to government furnished equipment in order to install it in a fixed facility instead of a transportable shelter were finalized. Initial work station hardware procurement and segment level testing of software began. Logistics support development continued, aiming at providing the maximum capability for integral Air Force maintenance support for TR-1 Ground Stations in the field. Changes resulting from the operational test of the prototype ground station, the Tactical Reconnaissance Exploitation Demonstration System, currently operational in Germany, were introduced in the TRIGS design.

(2) (U) FY 1988 Program: System software and hardware design will continue, resulting in a series of Critical Design Reviews in midyear. Major hardware procurement and assembly will begin. Segment level testing of software will begin. Logistics support development will continue, aimed at providing a maximum capability for integral Air Force maintenance support for TR-1 Ground Stations (TRIGS) in the field. Changes resulting from the operational test of the prototype ground station, currently operational in Germany, will be introduced in the TR-1 Ground Station design. The cost estimate is based on experience with the Tactical Reconnaissance Exploitation Demonstration System (TREDS) functional prototype. The estimate is also based on parametric analysis of limited cost, design and performance descriptions, Category III, Budgetary. The estimate assumes the program continues as a sole source development.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Software development and purchase of hardware for imagery exploitation, ground communication, and mission control will continue. System level integration will begin at the contractor's plant, bringing together the Advanced Synthetic Aperture Radar System (ASARS) II exploitation segments, mission control segment, and communications and support elements. This system level integration will highlight system shortfalls and correct them prior to overseas shipment. NATO funded construction of the overseas bunker will begin in FY 1989. Close liason with European commands is required to insure the site is prepared for system installation. Planning for the test and evaluation of the ground station will begin at Air Force Operational Test and Evaluation Center. Training equipment and course curriculums will be developed to insure fully trained personnel are available when the ground station becomes operational. We will continue to develop and purchase support equipment to support organic support.

(4) Program to Completion: This a continuing program. In FY 1990 contractor integration will be completed. Operator training will begin. In addition, design and hardware procurement for the second TR-1 ground station will begin. In the first quarter of FY 1990 the hardened facility will be ready for occupancy.

In 1993 system integration of the second ground station will begin at the contractor's facility, with shipment to Germany occurring in the fourth quarter.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) First TR-1 Contract | November 1979 |
| (2) (U) TREDS Contract Award | July 1981 |
| (3) (U) First TR-1 Delivered | September 1981 |
| (4) (U) ASARS II Operational Evaluation | November 1982 |
| (5) (U) ASARS II Production Award | September 1983 |
| (6) (U) TREDS Delivery to Europe | August 1985 |
| (7) (U) TREDS Operational Test Complete | December 1986 |
| (8) (U) TR-1 Ground Station Element Level Testing | August 1988 |

Program Element: 0207215F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: TR-1 Squadrons
Budget Activity: 4 - Tactical Programs

| | | Milestones | Dates |
|---|---|---|---|
| (9) | (U) | TR-1 Ground Station (TRIGS)Contractor System Integration | September 1989 |
| (10) | | TRIGS I Initial Operational Capability | [ ] |
| (11) | (U) | TRIGS II Integration | September 1993 |
| (12) | | TRIGS/TR-1 Full Operational Capability | [ ] |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: <u>4, Tactical Programs</u>
Program Element: <u>0207215F, TR-1 Squadron</u>

AS OF: 23 FEBRUARY 1988

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The TR-1 aircraft is a follow-on to the U-2R, whose required operational characteristics have been verified by over sixteen years of day to day operations. As such, no additional Development Test and Evaluation (DT&E) or Operational Test and Evaluation (OT&E) of the aircraft is accomplished under this program element. However, the TR-1 Tactical Reconnaissance System (TRS) development program does sponsor sensor and ground station test programs as summarized below.

DT&E of the

processing and reporting is complete. This system completed contractor integration and testing in October 1979, and Initial Operational Test and Evaluation in March 1980. All test program action items are complete, and all system deficiencies have been either addressed via changes to ongoing contracts, or programmed for outyear implementation pending approval of funds.

(U) The Advanced Synthetic Aperture Radar System (ASARS II) development effort consists of two major projects managed by the Aeronautical Systems Division. One of these projects is with the Hughes Aircraft Corporation for development of an airborne sensor and a radar ground processor. The second project involves design of a ground facility to exploit ASARS imagery. Multiple program requirements are being addressed in these projects to meet the need for strategic/national and tactical SLAR collection, processing, timely exploitation and reporting during peace, crisis and war. Specific system requirements for the U-2R, and tests conducted on the U-2R, apply directly to the follow-on procurement of the Advanced Synthetic Aperture Radar System airborne and ground elements for the TR-1.

2. Operational Test and Evaluation (OT&E): The Air Force Operational Test and Evaluation Center is managing the TR-1 Tactical Reconnaissance System (TRS) OT&E program. The TRS OT&E program consolidates test directives from the Side-Looking Airborne Radar (SLAR) PE 0604756F and where those programs provide capability as part of the TR-1 TRS.

Phase I involves the maximum utilization of previous test data to save resources. TRS is combining already operational equipments with new capabilities in development. Phase I consolidates test data from the conducted by Electronic Security Command (ESC) and AFOTEC and the Airborne Synthetic Aperture Radar System (ASARS) operational utility evaluation (OUE) conducted by AFOTEC. The notion is that, by using the previous test data as baselined capability, only enough data need be taken in future tests to verify that those systems still operate at least as well as baselined. The results of Phase I are as follows:

Budget Activity: 4, Tactical Programs
Program Element: 0207215F, TR-1 Squadron

Electronic Security Command (ESC) conducted an initial operational test and evaluation (IOT&E) of the original (prototype)

ESC conducted a reassessment of the prototype

An was conducted by Air Force Operational Test and Evaluation Center (AFOTEC) on all from 1 Oct 1983 to 12 January 1984. The report concluded that

AFOTEC conducted an Advanced Synthetic Aperture Radar System (ASARS II) Operational Utility Evaluation (OUE) which was completed in November 1982

Supportability, reliability, and maintainability were rated satisfactory. Minor problems in support hardware, Line Replaceable Unit (LRU) reliability, and degree of maintenance difficulty were observed.

AFOTEC conducted IOT&E (Phase II) of the TRS prototype and will conduct FOT&E (Phase III) of the follow-on TRS system.

(U) The European Central Region TR-1 TRS IOT&E (2) was accomplished from 16 June 1986 to 19 December 1986. The three critical issues of the TRS assessed were: (1) timely response to tasking, (2) utility of system products to the tactical commanders, and (3) adequacy of reliability and maintainability characteristics. The IOT&E took place in the European theater where the operational environment was favorable for all aspects of the test. Emphasis of the prototype testing was to validate design concepts in an operational environment and to provide constructive design inputs to the production system to maximize system effectiveness.

Budget Activity: 4, Tactical Programs
Program Element: 0207215F, TR-1 Squadron

This IOT&E was conducted on a functional prototype which included and developmental Advanced Synthetic Aperture Radar System II equipment. The prototype included all the functional elements of the production system.

The Tactical Reconnaissance System (TRS) prototype proved useful Service reports on these deficiencies were forwarded to the program office and solutions will be incorporated into the follow-on ground station. There is relatively low technical risk in correcting the identified design problems.

(U) The reports published to date are:

(1) Electronic Security Command (ESC), March 1980 (S/SCI).

(2) (U) Follow-up RTASS IOT&E Report, ESC, September 1981 (S/SCI).

(3) (U) Advanced Synthetic Aperture Radar System (ASARS II) Operational Utility Evaluation Final Report, Air Force Operational Test and Evaluation Center (AFOTEC), April 1983 (S/SENIOR YEAR Program Material).

(4) (U) RTASS FOT&E Final Report, AFOTEC, March 1984 (S/SI).

(5) (U) TR-1 Tactical Reconnaissance System IOT&E Report, AFOTEC, February 1987 (S).

3. (U) Systems Characteristics:

(U) ADVANCED SYNTHETIC APERTURE RADAR SYSTEM (ASARS):

| (U) Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Search Mode | | |
| Range | | |
| Swath Width | | |
| Squint Angle | | |
| Resolution | | |

| (U) Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| Spotlight Mode | | |
| Range | | |
| Spot Size | | |
| Squint Angle | | |
| Resolution | | |

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(U) TR-1 AIRCRAFT: All required operational characteristics verified by over 15 years of U-2R operation. Procurement organization will perform routine acceptance flight tests on each aircraft prior to delivery.

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| (U) IOT&E Test Report Publication and Dist. | Mar 87 | 26 Mar 87 | Completed as scheduled |
| (U) Test Results Briefings | Apr 87 | Apr 87 | Completed as scheduled |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| (U) None | | |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: #0207217F
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Follow-On Tactical Reconnaissance System
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 17,672 | 42,833 | 56,562 | Continuing | N/A |
| 3201 | Tactical Air Reconnaissance System | 9,126 | 33,041 | 46,362 | Continuing | N/A |
| 3364 | Joint Services Imagery Processing System | 8,546 | 9,792 | 10,200 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Follow-on Tactical Reconnaissance System (FOTR) and the associated Tactical Air Reconnaissance System (TARS) project is an essential element of the Advanced Tactical Air Reconnaissance System (ATARS) umbrella concept. The Program Element in conjunction with funding from PE 0603239F, Unmanned Air Reconnaissance System, focuses on full-scale development of a common family of Electro-Optical (EO) sensor suites (sensors, data-link sets, recorders, and reconnaissance management system) for upgrade of both USAF and Department of Navy (DON) manned and unmanned reconnaissance systems (TARS). Specifically, the Air Force will integrate EO sensor suites into the RF-4C, a Joint USN/USAF medium-range unmanned system and a follow-on tactical reconnaissance pod for carriage on a fighter aircraft. The DON, in a separate contract, plans for EO sensor suite integration into the medium-range unmanned system, upgrade of the USMC F/A-18D reconnaissance aircraft and transition of the USN F-14D Tactical Air Reconnaissance Podded System (TARPS) from film to EO capability. Concurrent development of a ground exploitation system will be conducted using modular technology derived from the USAF/USMC/USA Joint Services Imagery Processing System (JSIPS). JSIPS was formerly known as the Advanced Deployable Digital Imagery Support System (ADDISS). The ground station will have commonality to Air Force manned and unmanned systems. TARS is designed to meet the needs of the tactical commander for detection, location and classification of tactical targets with sufficient location accuracy and detail to permit the timely delivery of appropriate air or ground launched weapons. The Tactical Air Forces Statement of Need 320-79 and corresponding Justification for Major System New Start, as approved by the office of the Secretary of Defense in August 1982, identified the requirement for near-real-time intelligence information. These requirements will be met by a mix of tactical reconnaissance platforms including standoff and penetrating manned and unmanned vehicles.

Program Element: #020217F
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Follow-On Tactical Reconnaissance System
Budget Activity: #4 - Tactical Programs

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 17,672 | 55,561 | 54,084 | Continuing | N/A |

(U) Explanation of Changes: The FY 1988 reduction resulted from congressional action. The increase in FY 1989 resulted from a repricing action accomplished by HQ Air Force Systems Command following program redefinition by HQ Tactical Air Command.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Electro-Optical (EO) sensor suites developed in the Follow-on Tactical Reconnaissance Program and Tactical Air Reconnaissance System (TARS) project will be used to upgrade both Department of Navy and Air Force manned and unmanned vehicles. The Joint USN/USAF medium-range unmanned activities have been accomplished under PE 0603239F (Air Force Unmanned Air Reconnaissance System - UARS), PE 0604511N, W1870 (Navy Medium-Range Unmanned Vehicle), PE 0603635M (Marine Medium-Range Unmanned Vehicle - 1987) and PE 0604657M (Marine Medium-Range Unmanned Vehicle - 1988 and forward). An AF/USN Memorandum of Agreement (MOA), March 1985, designated the Air Force as lead service for sensor development and the USN as lead service for unmanned platform development. By Congressional direction, future unmanned development activites will be accomplished under a Program Element to be established and controlled by the Office of the Secretary of Defense. Navy manned activities will be accomplished under PE 0603261N. Initial design/development efforts for the Joint Services Imagery Processing System (JSIPS) were funded by PE 0207435F, Tactical Reconnaissance Imagery and Exploitation System. Army and Marine Corps JSIPS development funding are contained in PE 0603730A and PE 0604718M respectively.

6. (U) WORK PERFORMED BY: Contractors for EO sensor development have not been identified. The TARS Request for Proposal was released in May 1987. Contract award is anticipated in April 1988. During the Concept Validation Phase, General Dynamics, Fort Worth, Texas, was the prime contractor for demonstrating the capability of an EO sensor suite and completing the reconnaissance simulation testing. The Aeronautical System Division, Wright-Patterson AFB, Ohio, has overall in-house management responsibility for system development and study efforts for TARS (Project 3201). Electronic Systems Division, Hanscom AFB, Massachusetts, has responsibility for in-house management responsibility for ground processing and exploitation equipment (project 3364). The contractor for full-scale development of JSIPS is E Systems, Garland, Texas.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

Program Element: #0207217F
DOD Mission Area: #327 - TIARA For Tactical Air Warfare

Title: Follow-On Tactical Reconnaissance System
Budget Activity: #4 - Tactical Programs

(U) Project: 3201, Tactical Air Reconnaissance System

A. (U) Project Description: The Tactical Air Reconnaissance System (TARS) is a full-scale development project which meets the needs of tactical commanders for near-real-time detection, location and classification of tactical targets. Their needs will be met by a mix of tactical reconnaissance platforms including standoff and penetrating manned and unmanned vehicles. Program focuses on the development of a common family of electro-optical (EO) sensor suites (sensors, data-link sets, recorders and reconnaissance management system) for upgrade of both USAF and Department of Navy manned and unmanned reconnaissance systems. Specifically, the Air Force will integrate EO sensor suites into the RF-4C, a Joint USN/USAF Medium-Range unmanned system and a follow-on reconnaissance pod to be used on a fighter aircraft. The program includes an EO sensor suite that will detect, classify and identify tactical targets both moving and stationary. The TARS system will provide a near-real-time data-link capability of reconnaissance imagery. The EO sensor suite will be common to Air Force manned and unmanned systems. Funding for EO Suite development is provided under the TARS project and PE 0603239F, Unmanned Air Reconnaissance System (UARS).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Initiated source selection activity in anticipation of a Full-Scale Development (FSD) contract award for the EO sensor suite in April 1988. The EO sensor suite will be integrated into the RF-4C, Joint USAF/USN Medium-range Unmanned Air Reconnaissance System (UARS) and follow-on reconnaissance pod for carriage on a fighter aircraft. Engineering design studies were initiated to determine RF-4C integration requirements and technical specifications.

(2) (U) FY 1988 Program: Source selection will be completed with contract award in April 1988. The FSD program will begin for EO design efforts. Following the initial contractor design responses, the Program Office will conduct a Preliminary Design Review (PDR) to compare contractor proposals with required technical specifications. Following PDR, the Program Office will complete Critical Design Review (CDR) to finalize the EO sensor suite design and specifications. An Independent Cost Analysis (ICA) will be completed to update the preliminary cost estimates provided by HQ Air Force Systems Command Single Best Estimate.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The prime contractor will initiate fabrication and assembly efforts leading to nine engineering models to be delivered in FY 1991. In addition, the contractor will initiate development of support equipment to include common support equipment, peculiar support equipment and automated test equipment.

(4) (U) Program to Completion: After production decision, the system will enter into production and be fielded.

C. (U) Major Milestones:

Program Element: #0207217F — Title: Follow-On Tactical Reconnaissance System
DOD Mission Area: #327 - TIARA for Tactical Air Warfare — Budget Activity: #4 - Tactical Programs

| Milestones | | Dates |
|---|---|---|
| (1) (U) Program Initiation | | August 1982 |
| (2) (U) Concept Validation | | October 1984 |
| (3) (U) Full-Scale Development (FSD) (EO Sensor Suite) | *(Oct 1986) | May 1988 |
| (4) (U) Production Decision | *(Jun 1990) | August 1991 |

*Dates presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Changes:

(3) (U) Full-scale Development date changed due to restructure of program following Congressional reductions in PE 0207217F and PE 0603239F and Air Force repricing action for FY 1988 and FY 1989
(4) (U) Production decision date changed due to restructure of program.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3364, Joint Services Imagery Processing System (JSIPS)

A. Project Description: JSIPS, formally known as the Advanced Deployable Digital Imagery Support System, provides a transportable tactical capability to receive, process, and exploit, in softcopy or hardcopy,

JSIPS will provide the Tactical Air Reconnaissance System (TARS) project with a ground station using the modular, exportable technology developed under JSIPS. Specifically, JSIPS (TARS ground station) will develop an imagery exploitation ground station to receive data from the TARS EO-equipped platforms. Designed to meet the tactical commander's need for near-real-time imagery for the detection, location and classification of tactical targets, JSIPS will replace the present photo processing and interpretation facilities associated with RF-4C aircraft. JSIPS will support the EO-modified RF-4C, the Unmanned Air Reconnaissance System, and the Follow-on Tactical Reconnaissance Pod.

As part of a multi-service program, JSIPS also supports the USMC All Source Imagery Processor and Army Imagery Processing and Dissemination Processing System requirements.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The technical demonstrations by each contractor team were completed and evaluated to insure the ability of each team to meet critical technical characteristic requirements of the Joint Services Imagery Processing System (JSIPS). Following completion of the design phase, a Request for Proposal (RFP) was released, source selection completed and the FSD contract was awarded to E-Systems.

(2) (U) FY 1988 Program: Full-scale development (FSD) of the ground station will continue from efforts that began in FY 1987 and will be completed in early FY 1990. Software to support imagery exploitation and development of

a standard imagery console will constitute the major portion of this year's development. Additional efforts will include integration of commercial off-the-shelf software and unique hardware items.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Integration and testing of the JSIPS Ground Station will begin in FY 1989. This will include a period of joint testing of the Air Force, Army and Marine Corps Engineering Development Models with service specific testing to follow.

(4) (U) Program to Completion: Continue full-scale development of production ground stations.

C. Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Phase I Contract Complete | | December 1986 |
| (2) | (U) | FSD Request For Proposal Release | | February 1987 |
| (3) | (U) | Contract Award | * (June 1987) | August 1987 |
| (4) | | Initial Operational Capability (IOC) for JSIPS | * | |
| (5) | | Production Decision for JSIPS Ground Station | * | |

* Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes:

(3) (U) Actual date of contract award.
(4) (U) IOC redefined. The October 1989 date represented an interim capability.
(5) (U) Production decision date update based on actual contract award date.

10. (U) COOPERATIVE AGREEMENTS: The Air Force has entered into discussions with Germany and The Netherlands on the feasibility of a cooperative program. Both countries have expressed interest in upgrading their tactical reconnaissance capabilities and are considering the shift to EO imagery sensors. A cooperative project is being investigated based on the United States developing the sensor suite and designing the F-16 sensor pod. The allies would accomplish pod fabrication, aircraft integration and conduct flight testing. An USAF/USMC/USA Memorandum of Agreement has been reached that designates the USAF as the lead service for the development of JSIPS, establishes each Service's roles and responsibilities and defines fund sharing requirements. The USN has entered into discussions with the Air Force on the feasibility of becoming a member of the JSIPS development program along with the other services.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207247F
DOD Mission Area: 322 - TIARA for Tactical Land Warfare

Title: Air Force TENCAP
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 2859 | 312 | 323 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The primary objective of this program is to ensure national system support to our warfighters. In 1977 Congress directed each Service to establish a Tactical Exploitation of National Space Program Capabilities (TENCAP) office to improve military use of the national space systems. Air Force TENCAP initiatives include the development of procedures, tactics and interfaces (equipment and/or software) to guarantee national systems support to the tactical commander. This program also evaluates National Systems the impact and level of tactical utility. Tactical Impact Statements are prepared for Congressional review documenting the utility of new national programs and major modifications required to support tactical operations.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 102 | 313 | 324 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 actual increase results from a funds transfer into TENCAP for the purpose of procuring 15 CONSTANT SOURCE systems for a classified research and development program. Other changes reflect revised inflation indices.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. RELATED ACTIVITIES: As part of its functions, TENCAP strives to continuously expand the tactical use of existing national systems and is the "honest broker" for the Air Staff when evaluating the use of [ ] conventional systems support to combat operations. TENCAP formally interfaces with numerous national space programs/agencies, the Major Commands and their components, the Air Staff, Office of the Secretary of Defense, Secretary of the Air Force, and the other Services in order to effectively influence the designs and concepts of the national systems. Program Elements (PEs) [ ] are also related activities in that they provide [ ]

Program Element: 0207247F
DOD Mission Area: 322 - TIARA for Tactical Land Warfare

Title: Air Force TENCAP
Budget Activity: 4 - Tactical Programs

6. (U) WORK PERFORMED BY: Air Force management of this effort is under the Air Force Deputy Chief of Staff for Plans and Operations, Headquarters USAF, Washington, DC.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0207247F, Air Force TENCAP

A. Project Description: This program has as its main objective the development of procedures, tactics and interface equipment/software to expand tactical use of national space systems within an operational combat framework as well as to influence the design and operation of capabilities to improve tactical support. Efforts will include participation in tactical exercises, system interface, software/hardware development, related developmental studies and the development of Congressional Impact Statements for national space systems' major modifications and/or new starts in terms of their tactical combat operations utility.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: As the Air Force executive agent for the Joint Chiefs of Staff (JCS) Special Project 1987 POWER HUNTER, Tactical Exploitation of National Space Program Capabilities (TENCAP) provided and funded the development of prototype receive equipment for the exercise. POWER HUNTER provided tactical forces the opportunity to gain experience in the use of national intelligence systems in an exercise environment. The objectives were to evaluate dissemination of national system electronic intelligence reporting, collection management at the Tactical Air Control Centers (TACC), and alternative intelligence dissemination routing. Similar support will be provided for Pacific Air Force (PACAF) during the Pacific Exercise (PACEX) 1988 exercise. PACEX 88, scheduled for objectives include the evaluation of the use of: Numerous command unique initiatives were supported, such as the and the development of a collection management automation system. All have led to significant improvements to the tactical utility of national systems.

(2) FY 1988 Program: The primary RDT&E activity planned for FY 1988 is the development of a Tactical Impact Statement on a national program. Continuing exercise evaluation (PACEX 88), software development and interface/connectivity/procedural evaluation/development are also planned. In accordance with Secretary of the Air Force direction, Air Force TENCAP will develop a prototype testbed for the evaluation of CONSTANT SOURCE (a small ruggedized transportable UHF receipt exploitation system

Program Element: 0207247F
DOD Mission Area: 322 - TIARA for Tactical Land Warfare

Title: Air Force TENCAP
Budget Activity: 4 - Tactical Programs

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funding will be used for continuation of ongoing efforts; such as the continuation of studies of methods to locate relocatable targets and the identification of requirements for

will Special Project 89

The FY 1989 cost estimates for these activities are based on projections for continuing FY 1988 efforts into FY 1989 and previous completed cost data on support to JCS Special Projects. Additionally, we will expand Operations Test and Evaluation (OT&E) of CONSTANT SOURCE into the theaters to support Major Command requirements.

(5) (U) Program to Completion: Program is managed as a continuing level of effort.

C. (U) Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| (1) | | P400 Initial Operational Capability | |
| (2) | | Joint Chief of Staff (JCS) Special Project 88 | |
| (3) | (U) | Blue Flag Exercise Support | |
| (4) | (U) | Green Flag Exercise Support/Red Flag Support | Quarterly |
| (5) | (U) | Electronic Signal Parametric SON | Quarterly |
| (6) | | Constant Source Initial Operational Capability | June 1988 |
| (7) | | Constant Source Full Operational Capability | |
| (8) | | JCS Special Project 89 | |
| (9) | | Multi Spectral Imagery Initial Operational Capability | |
| (10) | (U) | JCS Special Project 91 | Open |

*Date presented in FY 1988/89 Descriptive summary.

(U) Explanation of Milestone Changes

(1) (U) One year delay in IOC resulted from the transfer of the contract from one contractor to another and extended contract renegotiations.

(2) Change reflects on-going effort to complete the post exercise documentation. Actual exercise

(8) (U) Date of exercise has been firmed up.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207316F — Title: Tacit Rainbow
DOD Mission Area: 224 - Defense Suppression — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | * | 79,150 | 39,323 | 10,829 | 129,302 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Services have an urgent need for a low-cost, programmable, loitering missile system that can search out and attack emitting enemy radars and jammers. This missile system will provide commanders with a weapon that can defeat/suppress the enemy's ability to acquire and attack friendly forces and jam friendly emitters. Both air and ground launch variants should be developed; maximum commonality of components between the variants is mandatory. The system must interface with existing and planned command, control, communications, and intelligence ($C^3I$) elements to be compatible with individual and Joint Service employment concepts. Tacit Rainbow full scale development is funded under this program element.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | * | 164,359 | 48,360 | 10,700 | 223,419 |
| Aircraft Procurement | * | 26,900 | 21,614 | 11,609 | 60,123 |
| Missile Procurement | * | 55,092 | 109,361 | 1,349,454 | 1,519,907 |

EXPLANATION: RDT&E: The apparent reductions in FY 1988 and 1989 are in fact no change for FY 1988 and an increase of $12.9 million for FY 1989. The totals contained funds that belonged to a classified program. Additional information is available through appropriate channels. The $12.9 million increase in FY 1989, a transfer from procurement, is needed to accommodate a slip of the test program into FY 1989 and to fund a common mission planning system (part of SAC's Strategic Mission Data Preparation System Phase III.) Also, Tacit Rainbow must be integrated with a newer version of the B-52G flight management software (FMS). Aircraft Procurement (launchers): Congressional action reduced launcher procurement by $22.3 million in FY 1988. There is no impact to the program if these funds are added in FY 1990 and FY 1991. The $3.3 million increase in FY 1989, a transfer from procurement, is partially to offset the FY 1988 Congressional action. This amount will procure six launchers. Missile Procurement: The $37.4 million reduction in FY 1989 reflects a $12.9 million transfer to RDT&E, a $3.3 million transfer to launcher procurement, and a $21.2 million budget reduction. The change in missile procurement quantities is due to three unrelated factors. One,

* in Classified Program Element

direction from the Assistant Secretaries of the three Services to pursue a second source competitive acquisition strategy at no additional cost to the program came after submittal of the FY 1988/FY 1989 President's Budget. Compliance with this direction required slipping procurement of the first lot into the next fiscal year and decreasing the planned procurement quantities for the next two fiscal years. The decrease in quantities is due to higher nonrecurring costs associated with a dual source production program vice a single source program. Two, completion of Development Test and Evaluation and Initial Operational Test and Evaluation, and hence the Milestone IIIA production decision, slipped into FY 1989. Given factor one, the test program slip has no impact on FY 1988 or FY 1989 procurement. Three, the $21.2 million budget reduction in FY 1989 and $16.2 million transfer to other appropriations reduced the planned competitive program procurement quantity from [ ] to [ ] missiles.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds | * | 4,600 | 24,914 | 37,586 | 67,100 |
| Quantities (launchers) | * | | | | |
| Missile Procurement: | | | | | |
| Funds | * | 55,092 | 71,967 | 1,394,741 | 1,521,800 |
| Quantities | * | | | | |
| Military Construction: | | | | | |
| Funds | * | 0 | 5,600 | 2,943 | 8,543 |

* In Classified Program Element

5. (U) RELATED ACTIVITIES: The Tacit Rainbow (TR) program is a Tri-Service effort with the Air Force serving as the Executive Service with Army and Navy personnel integrated into the Joint System Program Office (JSPO). The JSPO is maintaining a close relationship with the B-52 program office to assure proper implementation of aircraft modifications required to employ the TR vehicle. The TR vehicle is compatible with Air Force and Navy tactical aircraft suspension equipment and multiple carriage bomb racks. Funding for Navy-peculiar full scale development (FSD) and procurement is included in PE 0207316N.

6. (U) WORK PERFORMED BY: The Tacit Rainbow development and acquisition program is being managed by the Tacit Rainbow Joint System Program Office at the Aeronautical Systems Division, Wright-Patterson AFB, OH. In addition to Aeronautical Systems Division, other government organizations participating in the development effort include Air Force

Program Element: 0207316F
DOD Mission Area: 224 - Defense Suppression

Title: Tacit Rainbow
Budget Activity: 4 - Tactical Programs

Tactical Air Command, Langley AFB, VA; Air Force Strategic Air Command, Offutt AFB, NE; Air Force Logistics Command, Wright-Patterson AFB, OH; Warner-Robins Air Logistics Center, Robins AFB, GA; Naval Air Systems Command, Washington, DC; Naval Weapons Center, China Lake, CA; Army Materiel Command, Washington, DC; Army Missile Systems, Redstone Arsenal, AL; and Dugway Proving Ground, UT. Northrop Corporation Ventura Division, Thousand Oaks, CA was selected as the prime contractor for full scale development (FSD) and initial production of the air launch vehicles. Contractors will be competitively selected for second source production of the air launch vehicle.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) PROJECT: 0207316, TACIT RAINBOW

A. (U) Project Description: The Tacit Rainbow development program will significantly increase the Services' capability to suppress enemy air defenses by producing a low-cost, programmable, loitering missile system that can search out and attack emitting enemy radars and jammers. Air launch Tacit Rainbow vehicles will be compatible with Air Force B-52 aircraft and Air Force and Navy tactical aircraft (F-16, EF-111, A-6E). Using simplified seeker and guidance techniques and state-of-the-art technology, this autonomous weapon system is designed to produce a viable emitter attack capability at a cost significantly less than other anti-radiation attack weapon systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The critical design review of the air launch vehicle was conducted in October 1986. Contractor-conducted development flight tests were accomplished in preparation for the Air Force/Navy combined Development Test and Evaluation and Initial Operational Test and Evaluation (DT&E/IOT&E) using the B-52G and A-6E aircraft. An improvement to the missile seeker is in parallel development to meet joint operational requirements to attack a larger number of target types.

(2) FY 1988 Program: The FY 1988 funding will continue FSD of the air launch vehicle. The Joint System Program Office has negotiated a cap of $161 million to the FSD contract. A twenty-five vehicle Air Force and Navy combined DT&E/IOT&E using the Air Force B-52G and Navy A-6E aircraft will be started. The Air Force and Navy plan to buy a total of air launch vehicles, respectively. An independent single best cost estimate completed by the Air Force and Navy in February 1986 and approved by OSD projects a unit production cost of
An acquisition strategy has been developed to provide competition for full rate production of the air launch vehicle beginning with Lot 3 in FY 1991. The cost estimating confidence level is Level III for FSD and Level IV for production.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 funding will complete FSD of the air launch vehicle. It will fund Tacit Rainbow's portion of a mission planning system that is common with that of a classified program in addition to being compatible with SAC's Strategic Mission Data Preparation System Phase III.

PE: 0207316F

Integration of Tacit Rainbow with a new version of the B-52G flight management software (FMS) will also be provided for. Expanded seeker capabilities will be developed which will significantly expand the target base for Tacit Rainbow. A Milestone IIIA low rate initial production decision is planned for the second quarter with a sole source award to Northrop to produce [ ] missiles. The cost estimating confidence level for full scale development is Level III and for production is Level IV.

(4) Program to Completion: Starting in [ ] and completing in [ ] will be Initial Operational Test and Evaluation with the F-16, Follow-on Test and Evaluation with the B-52G, and a Navy-conducted Operational Evaluation. The Milestone IIIB full rate production decision is planned near the end of FY 1991. This will be the first dual source production year. Rotary launcher procurement will be completed in FY 1991. Air Force and Navy production for the air launch vehicle will be completed in [ ] respectively. FY 1993 will be the first year of full rate production of the air launch vehicle.

C. Major Milestones:

Air Launch Milestones

| | | | | Dates |
|---|---|---|---|---|
| (1) | (U) | Milestone IIIA Decision | (3rd Quarter FY 1988)* | 3rd Quarter FY 1989 |
| (2) | (U) | Complete Full Scale Development | (4th Quarter FY 1988)* | 3rd Quarter FY 1989 |
| (3) | (U) | First Production Delivery | (4th Quarter FY 1989)* | 1st Quarter FY 1991 |
| (4) | | Initial Operational Capability | [ | ] |

*Date presented in FY 1988/1989 Descriptive Summary

(U) Explanation of Milestone Changes:

(1) (U) Milestone IIIA extended 12 months due to 1) Decision to place the low rate decision after completion of 25 test flights vice 12 test flights, 2) Direction to start a competitive procurement acquisition strategy and 3) Delay in the start of the test program.
(2) (U) Full scale development completion date extended 9 months due to delay in start of test program.
(3) (U) First production delivery delayed 15 months due to extension of test program.
(4) Initial Operational Capability [ ] due to change in acquisition strategy from single source to dual source production and due to extension of test program.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): Full scale development of Tacit Rainbow is being managed by the Joint System Program Office (JSPO) at Aeronautical Systems Division, Wright-Patterson AFB OH. The Air Force Flight Test Center (AFFTC), Edwards AFB CA, is the Responsible Test Organization for DT&E. AFFTC will form a Combined Test Force to conduct the combined DT&E and Initial Operational Test and Evaluation (IOT&E). The Air Force Operational Test and Evaluation Center (AFOTEC) will have management responsibility for the dedicated OT&E events scheduled during the combined DT&E/IOT&E.

(U) A sole source contract was awarded to Northrop, Ventura Division, Thousand Oaks CA, for development of the Tacit Rainbow system.

Contractor development tests performed to date have consisted of ground and flight tests. The ground tests consisted of environmental, structural, reliability and instrumentation tests. The flight tests consisted of captive, safe separation and missile free flights. These tests demonstrated the ability of the missile to be launched from an aircraft, deploy its wing and control surfaces, start its engine, fly a preprogrammed flight path, acquire the target and terminally guide to that target.

An NC-130 and Navy A-7 aircraft served as launch platforms for these flight tests. The tests satisfactorily demonstrated the functional capability of the Block I system design to meet operational requirements. The Block I designation refers to a design which does not meet the full air launch environment from fighter/attack/bomber aircraft and does not include a doppler subsystem or components manufactured to military standards. A Block II design has been completed and is now in contractor demonstration testing.

(U) The warhead (WDU-30/B) is being developed by the Naval Weapons Center (NWC), China Lake CA. Engineering development including performance, environmental and safety demonstrations have been completed. Qualification tests of the production design are currently being conducted.

(U) Future testing involves further ground tests to fully qualify the missile and flight tests to demonstrate that it meets design specifications and operational requirements. Most of the airworthiness tests have been completed. The remaining ground tests include: environmental testing at the Pacific Missile Test Center (PMTC) CA; electromagnetic interference testing at PMTC and the Naval Surface Warfare Center (NSWC) VA; Hazardous Radiation Effects on Ordnance (HERO) testing at NSWC; explosive qualification and environmental safety verification tests at NWC; and reliability demonstration tests at PMTC. Other ground tests related to clearing the vehicle for carriage on and release from the B-52G and A-6E aircraft include wind tunnel tests at the Arnold Engineering and Development Center TN, electromagnetic compatibility testing, pit ejection, and loading/fit checks.

(U) The contractor is evaluating the missile system's performance through a series of captive, jettison, and free

flights using the B-52G and A-6E aircraft. The tests demonstrate safe separation through the aircraft flow field, wing and control surface deployment, engine start, free flight performance and terminal guidance. This phase of contractor testing is complete except for three free flights. An attempted free flight on 3 November 1987 failed due to a disconnected wire.

The combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) flight test program will consist of captive carriage and free flights released from the B-52G and A-6E aircraft. Test missions will be staged from Edwards AFB CA, and use the ranges at the Naval Weapons Center CA. This series of tests will demonstrate aircraft/missile compatibility and the missiles ability to navigate, acquire and attack an emitting target to include reloiter and reacquisition. Target arrays will increase in complexity throughout the test.

Twenty-five missiles will be launched during the test with DT&E and IOT&E data collected on each mission. Twenty-four missiles will be equipped with a telemetry/flight termination package, and one will have a live warhead.

2. (U) Operational Test and Evaluation (OT&E): This is a combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) program, with the Air Force Operational Test and Evaluation Center (AFOTEC) managing the OT&E portion. The DT&E/IOT&E will be conducted by a combined test force (CTF) at Edwards AFB CA, for approximately one year beginning in the second quarter of CY 1988. A total of 25 missiles will be fired from strategic (B-52G) and tactical (A-6E) aircraft during the test with both DT&E and IOT&E data being extracted from all firings. A minimum of 15 firings is planned with IOT&E scenarios to satisfy operational test objectives. The current Tacit Rainbow Test and Evaluation Master Plan was approved on 18 November 1987.

(U) All live firing missions will be flown from Edwards AFB CA. Representative mission profiles will be flown by the launch aircraft with the missile launches at low, medium and high altitude. Twenty-four of the twenty-five firings will be made with missiles configured with a telemetry package in place of the warhead and one firing will be with a live warhead. The twenty-four telemetry equipped missiles will fly realistic profiles terminating at the Naval Weapons Center range complex against representative target arrays. The live warhead round will fly a realistic profile in the Pacific Missile Test Center range complex and terminate against a shipborne target array.

(U) During the test, Air Force personnel of representative specialty codes will perform ground/aircraft checkout and loading of the launch equipment and missiles on the B-52. Navy personnel will perform ground checkout and loading on the A-6 aircraft. Navy personnel will also conduct an aircraft carrier suitability evaluation during the test.

(U) Data from the 25 live firing missions will be used to provide an OT&E input to a Milestone IIIA (low rate initial production) decision.

(U) The Milestone IIIB (full rate production) decision will be supported by an IOT&E Phase II with an F-16 and EF-111, FOT&E with a B-52G and a Navy-conducted Operational Evaluation (OPEVAL) with an A-6E. These tests are in the early planning stages and are planned to begin test approximately one year after the Milestone IIIA decision.

3. (U) System Characteristics: The air launch missile is designed to meet the requirements of the Mission Element Need Statement and Joint Systems Operational Requirements for an autonomous defense suppression weapon. The system requirements and thresholds shown below are extracted from the Joint Systems Operational Requirements, system specification and Test and Evaluation Master Plan.

| | Characteristics | Objective/Threshold | Demonstrated |
|---|---|---|---|
| a. | Performance | | |
| | Speed (KTAS) | | To be demonstrated |
| | Altitude (feet) | | |
| | launch | | |
| | bomber | | To be demonstrated |
| | fighter | | To be demonstrated |
| | carriage | | |
| | bomber | | To be demonstrated |
| | fighter | | To be demonstrated |
| | Accuracy | | |
| | navigation | | |
| | downrange error | | To be demonstrated |
| | crossrange error | | To be demonstrated |
| | loiter | | To be demonstrated |
| | terminal (ft, CEPn) (4) | | |
| | | | To be demonstrated |
| | | | To be demonstrated |
| | Range | | To be demonstrated |
| | Kill Probability | | To be demonstrated |
| b. | Reliability | | |
| | Mission (7) | | To be demonstrated |
| | Pre-launch (8) | | To be demonstrated |

| Characteristics | Objective/Threshold |
|---|---|
| c. (U) Missile Description | |
| Launch Weight (pounds) | 440 |
| Guidance | Passive, home-on-emitter |
| (U) Compatibility | B-52G, F-16, EF-111, A-6E (triple ejector rack, multiple ejector rack) |

Explanatory Notes:

(1) Minimum continuous, maximum continuous, maximum dash [ ]

(2) (U) Of distance traveled, whichever is greater.

(3) Maintain centroid of programmed pattern within [ ] of desired point at ranges up to [ ] from launch point.

(4) (U) Target at zero ft MSL, 30 knot wind vector. Circular Error Probable (CEP), normal to missile flight path.

(5) (U) Fire power kill, four hours to repair.

(6) Single shot fire power kill ($P_{fk}$) against a [ ] Target at zero ft MSL.

(7) (U) After pre-launch, includes all aspects from carriage through to warhead function.

(8) (U) Defined as passing go/no-go checks and accepting preflight mission programming.

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| Contractor Flight Test | 2nd Qtr CY87 | 3 Nov 87 | Unsuccessful |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Contractor Flight Tests (3 live launches) | 1st Qtr CY88 | Required before DT&E/IOT&E start |
| Start Combined DT&E/IOT&E | 2nd Qtr CY88 | 25 free flights, A-6E and B-52 aircraft. Start date slipped due to problems in contractor testing. |
| Carrier Suitability Testing | 2nd Qtr CY88 | 6 catapult launches and 11 arrested landings required to certify for Navy operations. |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207411F
DOD Mission Area: 352 - Air Warfare

Title: Overseas Air Weapon Control System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 6,305 | 6,920 | 6,069 | Continuing | N/A |
| 2026 | ETACCS/ACCS | 1,300 | 0 | 0 | 0 | 7,789 |
| 2704 | EIFEL Follow-On | 5,005 | 6,920 | 6,069 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Elektronisches Information Und Fuhrungsystem Fur Die Einsatzbereitschaft Der Luftwaffe (EIFEL) system satisfies the requirement for an automated command and control system for the United States Air Force-operated Allied Tactical Operations Center (ATOC) at Sembach, Germany. Under the EIFEL Follow-On (EFO) effort, the United States Air Force will cooperate with the Federal Republic of Germany in the joint development of a follow-on system to augment and expand the current EIFEL I system from the ATOC down to the wing/squadron level. The European Theater Air Command & Control System (ETACCS) has been established to analyze and coordinate the accomplishments of the North Atlantic Treaty Organization (NATO) team working on the NATO Air Command & Control System (ACCS) and to develop United States coordinated positions relative to ACCS issues.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 6,305 | 6,947 | 6,075 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: HQ United States Air Forces Europe (USAFE) is developing a unit level automation system, known as Wing Command and Control System which will be interfaced to EFO during the FY 1988-90 time frame.

6. (U) WORK PERFORMED BY: The EFO effort is being accomplished by Air Force Systems Command Electronic Systems Division Europe, Kapaun AS, GE. Mitre Corporation, Bedford, MA, is providing technical support in this effort. The German Dornier Corporation is developing software for the ATOC Host System Software.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2704, EIFEL Follow-On:

A. (U) Project Description: The Elektronisches Information Und Fuhrungsystem Fur Die Ernsatzbereitschaft Der Luftwaffe (EIFEL) system provides an automated capability for the command and control of tactical offensive air functions in the Central Region of the North Atlantic Treaty Organization. The current EIFEL I system provides an initial capability at the Allied Tactical Operations Center (ATOC). EIFEL Follow-On (EFO) will expand this capability and provide an interface to the units that execute the air tasking orders generated in the ATOC.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In FY 1987, development of the ATOC Host Standard Software (HSS) continued, consuming most of the funding. Planning and initial development activities for an expanded ATOC system continued. The MOU to add the United Kingdom, Belgium, and the Netherlands to the program was prepared for staffing.

(2) (U) FY 1988 Program: In FY 1988 the HSS development will continue and an interface between EIFEL and the Wing Command and Control System (WCCS) will be developed. In addition, development of ATOC improvements will continue within available funding. The Five Nation MOU will be signed. This is a Category III, Budgetary, cost estimate.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, the HSS will be completed and installed. The EIFEL/WCCS interface will be installed. A new central processing unit for the ATOC level system will be installed. This is a category III, Budgetary, cost estimate.

(4) (U) Program to Completion: This is a continuing program. The ATOC improvements development will continue until FY 1990. A multi-level security capability will be developed in FY 1991-92.

C. (U) Major Milestones:

| Milestones | Dates | |
|---|---|---|
| (1) (U) Amended MOU Signature | *(May 87) | Feb 88 |
| (2) (U) Host Standard Software (HSS) Installed | *(Jun 88) | Nov 89 |

*Date presented in the FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes

(1) (U) MOU signing slipped due to extended negotiations among the five signing nations.
(2) (U) HSS development slipped due to late delivery of German GFE to the EIFEL contractor.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: A Memorandum of Understanding (MOU) between the United States (US) and the Federal Republic of Germany (FRG) was signed in June 1986 for the Cooperative Software Development and Implementation for the Elektronisches Information Und Fuhrungsystem Fur Die Einsatzbereitschaft Der Luftwaffe (EIFEL) System. Total US contribution will not exceed 50 million Deutsch Marks (DM). The MOU is being modified to include the United Kingdom, Belgium, and the Netherlands. The German Dornier Corp was awarded the contract for the software development in 1985. The exact US share of the costs for this contract is yet to be determined. Negotiations are in process to restructure the contract with Dornier in light of the late delivery of German GFE to Dornier. Initial operating capability is projected for Nov 1989.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207412F
DOD Mission Area: 352 - Air Warfare

Title: Tactical Air Control System (TACS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 15,546 | 17,930 | 13,356 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Tactical Air Forces require development of a highly reliable, positive control system to fully exploit the inherent capabilities of tactical air power. The Tactical Air Control System (TACS) provides the means through which the Air Component Commander exercises control of his forces to accomplish his assigned mission. This program provides for major improvements to the existing TACS which was deployed in the sixties and is nearing the end of its useful life. Some of the programs include developing a new transportable modularized, software intensive, automated air command and control system and a series of electronic countermeasure programs to enhance the survivability and capabilities of the AN/TPS-43E surveillance radar. The TACS Improvement RDT&E program consists of the following efforts:

- Modular Control Equipment (MCE) Pre-planned Product Improvement ($P^3I$) program
- Anti-Radiation Missile (ARM) Decoy program

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 18,546 | 20,995 | 14,370 | Continuing | N/A |
| Other Procurement | 61,912 | 149,855 | 174,136 | Continuing | N/A |

EXPLANATION: (U)

- FY 1987: $12,474 thousand other procurement reduction due to deletion of spares funding from the Descriptive Summary; $3,000 thousand RDT&E reduction due to Air Force reprogramming to a higher priority program (Space Booster).
- FY 1988: $3,065 thousand RDT&E reduction due to OSD and Congressional reductions. Procurement reduction of $14,855 thousand is a combination of two events: spares funding has been removed from this Descriptive Summary (-$29,974 thousand) and Congress added $15,119 thousand to procure more MCE operations modules.
- FY 1989: $36,787 thousand procurement reduction due to budget restrictions; eliminates all ARM Alarm funds and money for one MCE operations module. Elimination of spares funds from this Descriptive Summary also is included in this reduction. $1,014 thousand in RDT&E funds were cut due to budget restrictions.

PE: 0207412F

4. (U) OTHER APPROPRIATION FUNDS ($ in thousands):

| | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| Other Procurement: | | | | | | |
| Funds: | | 49,438 | 135,000 | 137,349 | Continuing | N/A |
| Quantities: | ARM Alarm | 0 | 5 | 0 | 0 | |
| | ARM Decoy | 0 | 0 | 0 | 65 | |
| | MCE | 2 | 9 | 16 | 119 | |

5. (U) RELATED ACTIVITIES: Modular Control Equipment (MCE) production is a joint program with the United States Marine Corps (USMC) Tactical Air Operations Module (TAOM) program (PE 0206626M). The TAOM/MCE contract is administered by the USMC Systems Project Office based on a 1982 Memorandum of Agreement between the Navy and Air Force. The MCE Preplanned Product Improvement ($P^3I$) program will integrate the Joint Tactical Information Distribution System class 2H terminals (PE 0604771D and 0604754F), provide secure anti-jam VHF radios via the Single Channel Ground and Airborne Radio System (SINCGARS) program (PE 0207423F), and the Ground Attack Control Capability (GACC). Using the specially developed software adaptation, MCE will use information from the Joint Surveillance and Target Attack Radar System (J-STARS, PE 0604770F), the Advanced Synthetic Aperture Radar System (ASARS), and other intelligence sensors to execute interdiction against time-sensitive ground targets. This program is closely related to the Tactical Command and Control Advanced Development program (PE 0603789F) which does advanced development work for the TACS. Production of the Ultra-Low Sidelobe Antenna (ULSA) and signal processor improvements to the AN/TPS-43E radar continues in this PE. The improved radar will be nomenclatured the AN/TPS-75. Procurement of tactical fiber optic replacement for existing 26-pair copper cables is scheduled to start in FY 1991 (funded in this PE).

6. (U) WORK PERFORMED BY: Electronic Systems Division, Hanscom Air Force Base, MA, manages this program. Tactical Air Command, Langley Air Force Base VA, provides operational support, and MITRE Corp., Bedford, MA provides systems engineering. Major contractors include: Litton Data Systems Van Nuys, CA, for MCE and $P^3I$; ITT Corporation, Van Nuys, CA, Aydin Corporation, San Jose, CA, and LTV Corporation, Buffalo, NY for Anti-Radiation Missile (ARM) Decoy System.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0207412F, Tactical Air Control System (TACS).

A. (U) Project Description: The TACS program includes two ongoing research and development programs - MCE $P^3I$ and ARM Decoy. MCE will provide modular replacement units for the aging and obsolete operations shelters and ancillary equipment at the Control and Reporting Centers and Forward Air Control Posts of the TACS.

It will greatly increase weapons control capability, enhance the TACS survivability, mobility, and transportability, and handle the greatly increased command, control, and communications workload required in modern tactical combat scenarios. The Modular Control Equipment (MCE) Preplanned Product Improvement (P3I) Program will incorporate phased improvements to the basic MCE system so that MCE capabilities keep pace with the changing TACS environment. Phase one includes: integration with the Joint Tactical Information Distribution System (JTIDS) and the addition of Tactical Data Interchange Link (TADIL)-J software; the addition of the Single Channel Ground and Airborne Radio System (SINCGARS) Very High Frequency (VHF) anti-jam radio; the addition of software to perform Automated Air Tasking Order (AATO) functions; the addition of TRI-TAC and Ground Mobile Forces (GMF) satellite compatible interfaces; and the addition of software for the Ground Attack Control Capability (GACC). GACC is a software package that will provide the TACS with timely command and control of attacks against time-sensitive mobile ground targets (deep air interdiction). The GACC will employ MCE hardware. The Ultra-Low Sidelobe Antenna (ULSA), the Anti-Radiation Missile (ARM) Alarm Sensor, and the ARM Decoy (collectively known as SEEK SCREEN) are three efforts to enhance the survivability and effectiveness of the AN/TPS-43E radar. The ULSA program is in production with the contract for the final 46-lot expected in 3QFY 88. The ARM Alarm sensor funding in FY 89 was deleted due to budget reductions, so the effort will be terminated before entering the production phase. The ARM Decoy System, completing the full-scale design (FSD) phase, will provide the means to lure incoming ARMs away from the radar, and is the only remaining defensive system for the TACS radar.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: ARM Decoy completed FSD critical design reviews and engineering model construction was started. ARM Decoy remained on schedule for a late FY 1988 "fly-off," and early FY 1989 Initial Operational Test and Evaluation (IOT&E) completion. The MCE production contract was awarded on 29 May 1987, and the $P^3I$ request for proposal (RFP) was released in April 1987. Proposals were received in July 1987 but additional information was requested resulting in submittal of a revised RFP in early FY 1988. $P^3I$ award is expected in 2QFY 88. Arm Alarm DT&E and IOT&E were completed.

(2) (U) FY 1988 Program: In FY 1988, development work on theARM Decoy will be completed and combined DT&E and IOT&E will be started. The three competing contractors will beevaluated on the basis of best technical solution and competitive cost proposals submitted for production. The production RFP will be released in FY 1988. The MCE P3I program will continue full scale development work. Level IIdrawings and hardware design will be completed. Software coding work for the Ground Attack Control Capability (GACC), JTIDS, and Automated Air Tasking Order (AATO) efforts under $P^3I$ will be initiated. Software changes to existing modules necessary to integrate new $P^3I$ code will be started. In addition to software coding, work will continue on the integration/interface of the Class 2H terminal. The Modular Control Equipment (MCE) will continue production with 9 MCE operations module programmed for the FY 1988 buy. The cost estimates for the MCE Pre-planned Product Improvements ($P^3I$) and ARM Decoy are Category II, mature. These are current and valid estimates.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will complete combined developmental and operational testing for the ARM Decoy. Contract proposals from the three competing contractors

funded through Initial Operational Test and Evaluation (IOT&E) will be received and contract fact-finding and negotiations will be initiated for an FY 1990 contract award to the contractor with the best technical and cost solution. The MCE $P^3I$ Block 1 development will be 40 percent complete and in-plant breadboard and preliminary software testing initiated. Advanced study work will be initiated on Block 2 of $P^3I$. Block 2 will include expanding the MCE system display grid, expanding the MCE data link capability, interfacing the Combat Identification System-Indirect Subsystem (CIS-ISS) with the MCE, adding radar and radio remoting, and expanding data recording/reduction capabilities. The cost estimates for MCE $P^3I$ and ARM Decoy are Category II, mature. These are current and valid estimates.

(4) (U) Program to Completion: This is a continuing program. Full scale production of the ARM Decoy will be initiated and continue through FY 1994. MCE will continue production with the buyout of 155 units (148 shelterized modules and 7 "equivalent" training and support facilities). MCE $P^3I$ will continue with Block 1 development, with integration into the MCE production line scheduled for FY 1993. Block 2 preliminary design as described above will continue and include initial design studies for additional MCE interfaces (e.g. Milstar, Operations Intelligence Interface (OII), CIS-ISS, the Joint Surveillance and Target Attack Radar System (J-STARS), and the Advanced Tactical Surveillance System (ATSS) being developed in Program Element (PE) 0603789F, and the Advanced Synthetic Aperture Radar (ASAR)). MCE P3I will provide the vehicle for evolutionary improvements to the TACS equipment to be fielded in the 1990s and beyond so that it will be interoperable and compatible with new sensors and command and control systems fielded in the same timeframe or later, but insufficiently defined for inclusion now in the production MCE. $P^3I$ requirements and approval are validated in Program Management Directive 2023/0207412F.

C. (U) Major Milestones:

| PROGRAM | R&D CONTRACT AWARD | START IOT&E | PRODUCTION AWARD | INITIAL DELIVERY |
|---|---|---|---|---|
| (1) (U) ARM Alarm | Jun 83 | Jan 87 | (TERMINATED) | (N/A) |
| (2) (U) ARM Decoy | Jun 86 | Jul 88* | FY 90 | FY 91 |
| (3) (U) MCE | Jul 82 | Jun 86 | (Apr 87) May 87 | FY 90 |
| (4) (U) MCE P3I | (Feb 87) Mar 88 | (FY 90) FY 92 | FY 93 | (FY 92) FY 94 |

- Anti-Radiation Missile (ARM) Alarm Sensor
- ARM Decoy
- Modular Control Equipment (MCE)
- MCE Preplanned Product Improvement ($P^3I$) Program

() Indicates date presented in FY 1988/FY 1989 Descriptive Summary.
* Combined Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E).

(U) Explanation of Milestone Changes

(1) (U) Modular Control Equipment (MCE) production contract award delayed one month due to protracted negotiations.
(2) (U) MCE Pre-planned Product Improvement ($P^3I$) contract award delayed thirteen months due to delay in award of MCE production contract.
(3) (U) MCE $P^3I$ IOT&E start delayed two years due to delay in award of $P^3I$ contract as noted above, and longer development schedule than originally estimated.
(4) (U) MCE $P^3I$ initial deliveries delayed for same reason stated above. $P^3I$ will be incorporated into the FY 1993 production award.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207417F
DOD Mission Area: 352 - Air Warfare

Title: Airborne Warning and Control System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 99,092 | 94,630 | 174,774 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and integrates system improvements which will enable the E-3 to remain an effective, survivable airborne surveillance system for command and control of tactical forces and for strategic defense of the United States. The E-3 Airborne Warning and Control System (AWACS) overcomes ground-based surveillance system deficiencies through its unique ability to provide extended all altitude surveillance and, for the first time, the means to manage the air battle in real time. The AWACS contributes significantly to the effective use of U.S. forces supporting the North Atlantic Treaty Organization (NATO), the air defense of the United States and worldwide commitments.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: $in thousands

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 96,762 | 110,737 | 88,419 | Continuing | N/A |
| Aircraft Procurement (Mod kits, initial spares) | 36,100 | 22,100 | 31,500 | 542,600 | 632,400 |

EXPLANATION: (U) RDT&E: FY 1987 reflects reprogramming to initiate risk reduction activities for radar improvements. FY 1988 reflects distributed and undistributed Congressional reductions. FY 1989 reflects programmatic changes resulting from FY 1988 Congressional reductions, and includes funding for the second year of a restructured radar improvements development program. Procurement: FY 1987 reflects adjustments in contract costs and modification schedules. FY 1989 reflects reduction in HAVE QUICK A-Nets kit production quantities and adjustment in production schedules. Additional to Completion changes reflect adjustments in out-year modification schedules and pricing estimates.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement: (Class V Mod Kits, includes initial spares) | 36,600 | 22,100 | 14,600 | 621,348 | 694,648 |

5. (U) RELATED ACTIVITIES: The E-3 upgrade program draws equipment from several development programs. The Joint Tactical Information Distribution System (JTIDS) Class 2 terminal required for the Tactical Data Information Link J (TADIL J) standard message format is developed under PE 0604771D, Common JTIDS. Development and integration of the Global Positioning System (GPS) user equipment is funded in PE 0305164F, Navstar GPS User Equipment. HAVE QUICK improvements and development/integration of Single Channel Ground and Airborne Radio System (HAVE SYNC) are funded within PE 0207423F, Advanced Communications Systems. Development and integration of the improved Identification Functional Group is funded in PE 0604725F, Combat Identification Systems. United Kingdom and France direct commercial E-3 purchases include, and are dependent upon, the USAF-developed E-3 integration of the Tactical Data Information Link J (TADIL J) and central computer memory upgrades.

6. (U) WORK PERFORMED BY: The Electronic Systems Division (ESD) at Hanscom AFB, MA manages the U.S. program. ESD and the NATO Airborne Early Warning and Control Program Management Agency (NAPMA), Brunssum, Netherlands, jointly manage the Electronic Support Measures (ESM) cooperative development program. The major contractors are the Boeing Aerospace Company, Seattle, WA (air vehicle and integration); Westinghouse Electric Corporation, Baltimore, MD (radar); International Business Machines, Owego, NY (Data Processor); Singer Kearfott Corporation, Little Falls, NJ (Communication and Joint Tactical Information Distribution System (JTIDS) Digital Data Link); UTL Corporation, Dallas, TX (Electronic Support Measures Equipment).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0207417F Airborne Warning and Control System (AWACS)

A. (U) Project Description: The E-3 AWACS supports tactical air force and continental air defense force operations. AWACS overcomes the range, vulnerability, low altitude target detection, and electronic countermeasures deficiencies of present ground-based radar systems. It provides command and control functions for the Tactical Air Forces during deployment, counterair, interdiction, rescue, and airlift missions. AWACS provides command and control functions for strategic defense of the continental United States. It can be employed at any level of conflict. This Boeing 707 derivative contains radar, communications, identification sensors, and processors which provide an integrated air situation display at the operator consoles. Planned improvements will continue to exploit the AWACS's inherent capabilities and keep pace with evolving threat. These improvements include Electronic Support Measures (ESM), Tactical Data Link J (TADIL J)/JTIDS Class 2H terminal integration, central computer memory upgrade, and the NAVSTAR Global Positioning System (GPS) (collectively known as Block 30/35), as well as Mark XV, HAVE QUICK, and radar system improvements. Block 30/35 development will be under a single integrating contractor and retrofit will be accomplished as a single package. This will provide for significant efficiencies in system development and schedules of test assets, and will also minimize operational aircraft downtime during retrofit. ESM will provide a passive detection, location, and identification capability against

airborne, shipborne, and ground-based emitters. Incorporation of TADIL J and the JTIDS Class 2H terminal will provide secure, jam-resistant communications with the fighter force and ground sites. The GPS system will replace the Omega navigation equipment and will provide more accurate position and velocity information to support command and control. The Mark XV IFF will provide a secure, anti-jam IFF capability and eliminate current anomalies such as the E-3 IFF jitter and mode/code availability and reliability problems. HAVE QUICK A-NET, a communications electronic counter-counter measures improvement, provides more radios and permits simultaneous operation. HAVE QUICK IIA will provide faster frequency hopping radios. The Radar System Improvement Program (RSIP) restores required E-3 surveillance capability against the evolving threats posed by low radar cross-section fighters and cruise missiles, and improves ECCM.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Improved Radar Data Correlator (IRDC) validation efforts completed. Full scale development (FSD) of the IRDC and the Improved Radar Control and Maintenance Console (IRCMC) were deferred due to fiscal constraints. After a review of alternatives, IRDC/IRCMC was restructured into a Radar System Improvement Program (RSIP) to provide needed radar detection sensitivity upgrades, and pre-FSD risk-reduction activities were started for RSIP. Studies also began on the application of Very High Speed Integrated Circuits (VHSIC) for the E-3. Trainer External Simulation System (TESS) full scale development (FSD) continued. HAVE QUICK A-Net FSD continued. Block 30/35 FSD began.

(2) (U) FY 1988 Program: RSIP risk-reduction activities will complete, and FSD will begin. Block 30/35 FSD will continue and the system Preliminary Design Review (PDR) will occur. HAVE QUICK A-Net development efforts and flight tests are scheduled to be completed, and the program is planned to begin production. Trainer External Simulation System (TESS) FSD will continue. Mark XV Identification Friend of FOE (IFF) integration studies are also scheduled to begin for the improved Identification Functional Group. All estimates are Category III budgetary cost estimates.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full scale development for Block 30/35 will continue and a system Critical Design Review (CDR) will occur. The Electronic Support Measures (ESM) system will complete engineering test and evaluation and will begin flight testing. The Radar System Improvement Program (RSIP) FSD will continue, and a PDR and CDR will occur. RSIP includes comprehensive upgrades of radar signal processing hardware, software, and man/machine interfaces to achieve improved system sensitivity and target signal processing from the current radar antenna and transmitter equipment. RSIP will also improve ECCM and radar reliability and maintainability. RSIP will dovetail with Block 30/35 depot installation to minimize aircraft downtime. TESS FSD will be completed. All FY 1989 estimates are Category III budgetary cost estimates. Estimates for these FSD programs were reviewed in March 1987 and are based on program office estimates with contractor engineering and proposal inputs.

C. (U) Major Milestones:

| | | | | |
|---|---|---|---|---|
| (1) | (U) | E-3A Engineering Development Contract Award | | July 1970 |
| (2) | (U) | Start of E-3 production | | March 1975 |
| (3) | (U) | Interim Operational Capability (Core Configuration) | | April 1978 |
| (4) | (U) | E-3A Standard Configuration Flight Test Complete | | October 1981 |
| (5) | (U) | Command and Control Improvements (Block 20/25) Flight Test Complete | | March 1984 |
| (6) | (U) | Last Production Aircraft Delivered | | June 1984 |
| (7) | (U) | Improved Radar Data Correlator (IRDC) Validation Phase Complete | | May 1987 |
| (8) | (U) | HAVE QUICK A-Net Flight Test Complete | *(September 1987) | January 1988 |
| (9) | (U) | Trainer External Simulation System (TESS) Installation Complete | *(April 1988) | January 1989 |
| (10) | (U) | Electronic Support Measures (ESM) Flight Test Complete | | December 1989 |
| (11) | (U) | Block 30/35 Flight Test Complete | | November 1990 |
| (12) | (U) | Block 30/35 Functional/Physical Configuration Audits (FCA/PCA) Complete | | March 1991 |
| (13) | (U) | Radar System Improvement Program (RSIP) Flight Test Complete | | September 1991 |
| (14) | (U) | RSIP FCA/PCA Complete | | December 1991 |

* Date presented in FY 1988/1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(8) (U) Slip in HAVE QUICK A-Nets flight test due to qualification test unit fabrication problems.

(9) (U) Slip in Trainer External Simulation System (TESS) installation/checkout due to engineering changes and unresolved claims.

9. (U) COOPERATIVE AGREEMENTS: The United States and the North Atlantic Treaty Organization (NATO) are jointly developing and integrating a common ESM package for U.S. and NATO E-3 aircraft. Program management and coordination arrangements are outlined in the E-3 ESM Cooperative Research and Development Agreement. Twelve of the thirteen member nations of the NATO Airborne Early Warning and Control Program Management Organization (NAPMO) are participating. Boeing Aerospace Company, Seattle, WA is the prime contractor for ESM integration, and UTL Corporation, Dallas, TX, is the major U.S. vendor for the ESM equipment. Foreign contractor involvement is planned, but the contractors have not been selected. ESM full scale development (FSD) began in FY 1987 as part of the Block 30/35 upgrade of the U.S. E-3 aircraft. Total FSD cost is estimated at $150 million with NATO contributing a 35 percent share.

Budget Activity: 4, Tactical Programs
Program Element: 0207417F, Tactical Airborne Command and Control System (E-3A)

## Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The E-3A DT&E test program was combined with Initial Operational Test and Evaluation (IOT&E) test objectives in as realistic an operational environment as possible. The prime development contractor is The Boeing Company, and Air Force management is provided by Electronic Systems Division (ESD), Hanscom AFB MA. The overall objectives of the test effort were to: (a) validate/verify E-3A performance in accordance with design specifications; (b) determine E-3A performance and capability to fulfill operational requirement including interservice interoperability demonstrations; and (c) verify Air Force capability to support the E-3A with standard operational maintenance, logistics and training units using prescribed procedures.

(U) The first phase of three DT&E phases used a Brassboard engineering model and tested the airworthiness of the rotodome, demonstrated the feasibility of competing overland radar technologies (Hughes and Westinghouse) and demonstrated successful integration of radar targets and computer display equipment. Phase I was flown from March through November 1972, and resulted in Westinghouse being selected to continue radar development.

(U) The Systems Integration Demonstration (Phase II) demonstrated successful integration of a single suite of mission avionics which was tested in an electronic countermeasures environment. These tests were flown from March through October 1974 and met or exceeded the performance demonstrated during the Brassboard phase. Test results from the systems integration demonstration phase provided the basis for a production decision.

(U) Phase III was planned to complete air-vehicle, climatic, and mission avionics qualifications and acceptance testing of the core configured E-3A. Three development aircraft and the first production aircraft were flown during this phase from August 1975 through January 1977.

2. (U) Operational Test and Evaluation (OT&E): The E-3A test program has been conducted as a combined DT&E/IOT&E.

(U) Core E-3A Follow-on Operational Test and Evaluation

(U) General. The E-3A test program was conducted as a combined DT&E/IOT&E. ESD is responsible for DT&E. TAC, the operational command, is responsible for conduct of E-3 enhancement IOT&E. AFOTEC monitors the IOT&E program.

(U) Core E-3A Follow-on Operational Test and Evaluation (FOT&E). FOT&E, initiated in January 1977, was conducted in two phases with operational crews using production aircraft, training equipment, and support equipment.

Budget Activity: 4, Tactical Programs
Program Element: 0207417F, Tactical Airborne Command and Control System (E-3A)

(U) Follow-on operational Test and Evaluation (FOT&E) Phase I, managed by the Air Force Operational Test and Evaluation Center (AFOTEC), was completed in February 1978. The results of the first phase of FOT&E were reported in the AFOTEC Airborne Warning and Control System (AWACS) FOT&E Phase I FInal Report, July 1978. Test results confirmed that the production E-3A can effectively and efficiently perform its prescribed mission and that the E-3A will greatly enhance the capability of the Air Force to conduct tactical air operations. However, several significant reliability and maintainability problems and deficient logistic support areas were identified for improvement.

(U) FOT&E Phase II, managed by the Tactical Air Command, was initiated in March 1978 to refine initial operational test and evaluation (IOT&E) and Phase I FOT&E assessments with emphasis on tactics and procedures. This testing was completed during May 1980. Test reporting by the United States Air Force Tactical Fighter Weapons Center was accomplished in two parts. Part A of the final report covering the period March 1978 - May 1979 was published in May 1980 titled, Volume I, E-3A Airborne Warning and Control System (AWACS) Follow-on Operational Test and Evaluation (FOT&E), Phase II. Part B was published in October 1980 titled, Volume II, E-3A Airborne Warning and Control Systems (AWACS) Follow-on Operational Test and Evaluation (FOT&E), Phase II. A separate built-in-test/faulr-isolate test report by the United States Air Force Tactical Fighter Weapons Center was publish in June 1981 titled, Final Report, E-3A Surveillance Radar Built-In-Test (BIT)/Fault-Isolate-Test (FIT) Evaluation.

(U) E-3 Enhancements IOT&E

(U) Decision Coordinating Paper (DCP) 5, Revision 3, 5 March 1976, approved continued production of the E-3A, and the development of a selected set of system enhancements chosen to provide a fully effective worldwide force. The enhancements were to be developed as separate entities and integrated into the E-3A for testing as the enhancement items became available. In May 1976, the Deputy Secretary of Defense directed the Air Force to plan for an Office of the Secretary of Defense (OSD) review of the AWACS enhancement program when the respective enhancement development efforts are essentially completed. He further stated that it is contemplated that the Defense Systems Acquisition Review Council (DSARC) would then review development and test status and consider the operational utility of each enhancement for the DSARC review. In December 1978, the North Atlantic Treaty Organization (NATO) signed an agreement with the US Government (as their agent) for the procurement of 18 E-3A aircraft. To support this commitment and the US standard configured E-3A aircraft, the Air Force received approval of the OSD for limited production authority for a Maritime Surveillance Capability (MSC) radar and a Joint Tactical Information Distribution System (JTIDS) capability in E-3A DCP, No. 5, Revision IV, 6 March 1980. Results of the JTIDS test were reported in the December 1987 Air Force Test and Evaluation Center (AFTEC) E-3A Joint Tactical Information Distribution System (JTIDS) Adaptable Surface Interface Terminal Initial Operational Test and Evaluation Report. The IOT&E of the US Standard E-3A and the Continental United States portion of the NATO E-3A was conducted by the Air Force Test and Evaluation Center (AFTEC) from 15 September through October 1981. The results of this effort were reported in the AFTEC US/NATO E-3A IOT&E Final Report, March 1982. Overall operational effectiveness and suitability were satisfactory and the US/NATO E-3A, as tested, supported the user's operational requirements.

Budget Activity: 4. Tactical Programs
Program Element: 0207417F, Tactical Airborne Command and Control System (E-3A)

(U) The Block 20/25 Modification program retrofits Block 01 (Core) and Block 10 (Standard) configured E-3As. Block 20 consists of Block 01 plus Joint Tactical Information Distribution System (JTIDS), computer modification, 1 high frequency (HF) radio, 5 ultra-high frequency (UHF) radios, and 5 situation display consoles (SDCs). Block 20 aircraft have been redesignated E-3C aircraft. Initial operational test and evaluation (IOT&E) of the Block 20/25 configuration was not required due to similarily with the Block 10 configuration which completed operational tests.

The Electronic Support System (ESS) was installed in the E-3 to

The ESS consists of hardware developments and software modifications. The hardware

The software modifications permit the AWACS Airborne Operational Computer program

Since ESS was a Quick Reaction Capability (QRC) program, a comprehensive DT&E was not planned. IOT&E. for ESS was conducted in two phases by Tactical Air Warfare Center (TAWC) between 18 April 1984 and 7 December 1984. Phase I tested ESS installed on the Core E-3, and Phase II tested ESS installed on the Standard E-3. Each phase had three segments: Segment 1 was accomplished by Det 1 USAFTAWC, Seattle WA,

Segment 2 was conducted using operationally qualified 552 Airborne Warning and Control Wing (AWACW) personnel

Segment 3 was conducted using operationally qualified 552 AWACW personnel

IOT&E demonstrated

IOT&E was conducted in November and December 1986 in two parts. Part one involved testing

using Nellis AFB Nevada ranges. Part two addressed ESS effecftiveness

(U) The HAVE QUICK A-Nets modification program will retrofit Block 20 E-3B and Block 25 E-3C configured aircraft to incorporate a full HAVE QUICK capability for eight ultra high frequency (UHF) radios per aircraft. HAVE QUICK provides an air-to-air and air-to-ground jam resistant UHF voice communications capability. HAVE QUICK A-Nets is a Quick Reaction Capability (QRC) program. DT&E was conducted in December 1987 and January 1988 to verify the A-Nets design solution. Additional DT&E will be conducted in April 1988 if required. IOT&E objectives will be accomplished in conjunction with the DT&E effort.

(U) The Block 30/35 modification will retrofit Block 20 E-3B and Block 25 E-3C aircraft. This mod block update consists of Electronic Support Measures (ESM), Tactical Data Information Link J (TADIL-J) with computer memory upgrade, and the Navstar Global Positioning System (GPS). ESM will be managed jointly with the North Atlantic Treaty

Budget Activity: <u>4. Tactical Programs</u>
Program Element: <u>0207417F, Tactical Airborne Command and Control System (E-3A)</u>

Organization (NATO) as a Cooperative Research and Development program for integration of a common ESM system onboard US and NATO E-3 aircraft. IOT&E for the Block 30/35 modifications is planned in two phases: Phase I IOT&E of the US/NATO ESM system, and; Phase II IOT&E for the remaining US Block 30/35 upgrades. The Block 30/35 FSD full scale development contract was awarded in May 1987. Phase I IOT&E is planned for FY 1990 and Phase II is planned for FY 1991.

(U) A Radar System Improvement Program (RSIP) is planned to upgrade the operational performance and reliability and maintainability of the AWACS radar. RSIP is planned for a late FY 1988 FSD contract award. IOT&E is planned for FY 1991.

(U) Published OT&E Reports:

(1) <u>AWACS IOT&E Final Report</u>, November 1974, (S).

(2) <u>AWACS Free Play Test</u>, June 1975, (S).

(3) <u>AWACS Special IOT&E</u>, July 1975, (S).

(4) <u>AWACS Phase III IOT&E Final Report</u>, September 1977, (S).

(5) <u>AWACS POT&E Phase I Final Report</u>, July 1978, (S).

(6) <u>E-3A Joint Tactical Information Distribution System (JTIDS) Terminal IOT&E Final Report</u>, December 1987 (S)

(7) <u>Vol I, E-3A, AWACS FOT&E Phase II</u>, May 1980, (S).

(8) <u>E-3A Maritime Surveillance Capability (MSC) Prliminary Operational Effectiveness Assessment</u> Report, October 1980, (S).

(9) <u>Vol II, E-3A AWACS FOT&E, Phase II</u>, March 1891, (S).

(10) <u>Final Report, E-3A Surveillance Radar Built-in-Test (BIT)/Fault-Isolate-Test (FIT) Evaluation</u>, June 1981, (U)

(11) <u>US/NATO E-3A IOT&E Final Report</u>, March 1982, (S).

Budget Activity: 4, Tactical Programs
Program Element: 0207417F, Tactical Airborne Command and Control System (E-3A)

3. (U) System Characteristics:

(U) Comparison: Core, Standard, Block 20, and Block 25 Configurations

| (U) General: | E-3A/CORE | E-3A/STANDARD | E 3B/BLK 20 | E-3C/BLK 25 |
|---|---|---|---|---|
| Crew Size | 17 | 17 | 22 | 22 |
| Maritime Radar Capable | NO | YES | PARTIAL | YES |
| Joint Tactical Information Distribution System (JTIDS( Capable | NO | YES | YES | YES |
| **(U) Hardware:** | | | | |
| Consoles | 9 | 9 | 14 | 14 |
| Ultra High Frequency (UHF) Radios | 14* | 14* | 19** | 19** |
| High Frequency Radios | 2 | 3 | 3 | 3 |
| Very High Frequency/Amplitude Modulation Radios | 3 | 3 | 3 | 3 |
| Very High Frequency/Frequency Modulation Radios | 1 | 1 | 1 | 1 |

* Provides 8 mission UHF nets
** Provides 13 mission UHF nets

Budget Activity: 4, Tactical Programs
Program Element: 0207417F, Tactical Airborne Command and Control System (E-3A)

Capability:

| | E-3A/CORE | E-3A/STANDARD | E-3B/BLK 20 | E-3C/BLK 25 |
|---|---|---|---|---|
| Radar Targets/Scan | | | | |
| Identification Friend or Foe Targets/Scan | | | | |
| Data Processing Track Capacity | | | | |
| Data Processing Simultaneous Intercept | | | | |

(U) Comparison: E-3A Core (Block 01) Requirements to Demonstrated Performance

| Technical Characteristics: | E-3A CORE REQUIREMENTS | DEMONSTRATED PERFORMANCE |
|---|---|---|
| Detection Range (0.9 Probability in 1 Minute) | | |
| High Altitude Bomber (Nautical Miles) | | |
| Low Altitude Fighter Over Land (Nautical Miles) | | |
| Crew Size | 17 | 17 |
| System Track Capacity | | |
| Simultaneous Intercepts | | |
| Targets Position Accuracy (Nautical Miles) | | |
| Time on Station at 1000 Nautical Miles from Base in hours | 6.1 | 6.2 |

(U) Reliability and Maintainability Characteristics:

| | | |
|---|---|---|
| Probability of Completing 9 Hour Mission | 0.88 | 0.88 |
| Maintenance Manhour/Flight Hour | 28.0 | 33.9* |
| In-Commission Rate | 80% | 95.7% |
| Probability of Fault Detection | 95% | 97% |
| Probability of Fault Isolation (To 3 Primary Units) | 90% | 95 |
| Turn Around Time | 90% in 5.5 hrs | 90% in 4.8 hrs |
| Probability of not Detecting Failure | 0.08 | 0.03 |

*Actual data experience during FY 1984 for all E-3A aircraft (includes Core and Standard configurations) delivered to Tactical Air Command.



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Budget Activity: 4. Tactical Programs
Program Element: 0207417F, Tactical Airborne Command and Control System (E-3A)

(U) Comparison: E-3A Standard (Block 10) Design Requirements to Demonstrated Performance

| Technical Characteristics: | THRESHOLD | GOAL | DEMONSTRATED PERFORMANCE |
|---|---|---|---|
| Maritime Surveillance Capability | | | |
| Maximum Detection Range (Nautical Miles) | | | |
| Fast Patrol Boat | | | |
| Destroyer | | | |
| Maritime Targets Tracking Accuracy | | | |
| Position (Nautical Miles) | | | |
| Heading (Degrees) | | | |
| Speed (Knots) | | | |
| Maritime Targets Position Accuracy with Electronic Countermeasures (Nautical Miles) | | | |
| Maritime Targets Detection Range with Electronic Countermeasures (Nautical Miles) | | | |
| Maritime Target/Land Resolution (Nautical Miles) | | | |
| Joint Tactical Information Distribution System | | | |
| Message Transfer Ratio (Percent) | | | |
| Electronic Counter-Countermeas Margin (Decibels)+ | | | |
| Net Initialization Time (Minutes) | | | |
| Net Entry Time (Minutes) | | | |
| Terminal Initialization Time (Minutes) Automatic | | | |

* Sea states were defined as M-moderate (1-5ft), R-rough (5-8ft), VR-very rough (8-12ft), and H-high (over 12ft).
** Not obtained during Initial Operational Test and Evaluation (IOT&E) conducted 15 September to 30 October 1981.
\+ Node 1 double pulse continuous full band average jammer power divided by average signal power.
++ Estimated based on manual initialization time of

Budget Activity: 4. Tactical Programs
Program Element: 0207417, Tactical Airborne Command and Control System (E-3A)

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
| --- | --- | --- | --- |
| DT&E | May 87 - Sep 87 | Dec 87 - Jan 88 | HAVE QUICK A-Net QRC Evaluation, includes IOT&E objectives |

T&E Activity (Next 12 Months)

NONE

AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0207423F
DOD Mission Area: 345 - Tactical Communications

Title: Advanced Communication Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 29,900 | 29,883 | 10,806 | 1,000 | 270,531* |
| 2614 | HAVE SYNC (Single Channel Ground and Airborne Radio System VHF (SINCGARS-V)** | 5,249 | 4,312 | 3,500 | 1,000 | 47,317 |
| 2982 | HAVE QUICK II | 24,651 | 25,688 | 7,306 | 0 | 95,329 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Existing Soviet capabilities in communications jamming are sufficient to severely disrupt tactical Ultra High Frequency (UHF) and Very High Frequency (VHF) communications. Extensive communications jamming, as demonstrated during the 1973 Mid-East War, is expected to limit effectiveness of UHF and VHF voice communications. The Air Force relies on UHF communications for primary tactical command and control. VHF communications are vital for interoperability/coordination between Air Force and Army forces. Disruption of any of these critical communications would significantly degrade the effectiveness of our combat forces. The Air Force will participate with the Army to plan for integration of the SINCGARS-V anti-jam (AJ) capability into those weapon systems requiring direct communication with Army and Navy forces using SINCGARS-V. This is part of an overall requirement directed by the Joint Chiefs of Staff. HAVE QUICK is a near-term program applying demonstrated technology and providing an urgently needed resistance to jammers while additional performance features and operational enhancements are being developed. HAVE QUICK II is the program to develop those HAVE QUICK operational enhancements and performance improvements required to meet the evolving, increasingly sophisticated communications jamming threat. HAVE QUICK and HAVE QUICK II are the current standards for jam-resistant voice communications within NATO. HAVE QUICK IIA (fast frequency hopping capability) is the effort currently under development to further enhance our anti-jam robustness against a variety of communications jamming threats. HAVE QUICK IIA has been offered and accepted by NATO as the foundation for their long-term jam-resistant voice communications efforts. A NATO Standardization Agreement (STANAG) for this long-term system is currently in coordination.

* The Total Estimated cost includes $127.885 million which was expended on the Enhanced Joint Tactical Information Distribution System (EJS). This project was terminated in April 1986. The EJS technology was transferred to an advanced development project in another program element (PE 0603727F).

** Air Force Airborne SINCGARS was renamed HAVE SYNC in FY 1987. This was a name change only; performance requirements and contractual arrangements were not changed.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 31,900 | 34,549 | 11,089 | 0 | 276,363 |
| Aircraft Procurement | 42,600 | 9,000 | 31,156 | 482,909 | 585,565 |
| Other Procurement | 14,512 | 5,963 | 7,810 | 174,299 | 222,479 |

**EXPLANATION: (U)** The FY 1987 decrease in RDT&E funding of $2.0 million is the result of a Gramm-Rudman-Hollings (G-R-H) reduction. The FY 1988 decrease in RDT&E funding reflects a Congressional reduction of $4.5 million and an adjustment for inflation (decrease) of $.2 million. An estimated $1.0 million in additional RDT&E funding is required (beyond FY 1989) to integrate the HAVE SYNC radio into selected follow-on airborne platforms (i.e., A-7, C-141, C-5, etc.). The FY 1987 and FY 1988 reductions in aircraft procurement of $3.3 million and $1.5 million, respectively, are the result of Class V modification adjustments. The FY 1989 reduction in aircraft procurement of $7.8 million resulted from an Air Force decision to rephase (i.e., slow down) HAVE QUICK IIA production. Additional differences in FY 1987 and FY 1989 aircraft procurement ($3.0 million and $1.7 million, respectively) reflect the fact that spares dollars are not included within the aircraft procurement totals. The FY 1987 reduction in other procurement of $7.8 million is the result of an Air Force reprogramming ($5.0 million) and an adjustment in spares funding ($2.8 million). The reductions in FY 1988 ($.9 million) and FY 1989 ($1.3 million) other procurement are the result of adjustments in sparing levels.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement | | | | | |
| 2982 - HAVE QUICK II* | | | | | |
| Funds | 36,300 | 7,500 | 21,700 | 204,700 | 296,000 |
| Quantities (Kits) | 6,085 | 227 | 806 | 12,839 | 28,017 |
| Other Procurement | | | | | |
| 2982 - HAVE QUICK II* | | | | | |
| Funds | 6,685 | 5,059 | 6,532 | 67,235 | 113,679 |
| Quantities (Kits) | 240 | 416 | 970 | 2,137 | 5,278 |

* Unit prices of kits vary according to improvement(s) being provided in individual kits and according to specific radio system configuration or support equipment being modified or acquired.

5. (U) RELATED ACTIVITIES: The Air Force is participating in the Army Single Channel Ground and Airborne Radio System-VHF (SINCGARS-V) program, PE 0603746A, as part of the Joint Chiefs of Staff validated Joint Operational Requirement. Requirements and technical approaches are being worked with the Navy and Army to insure interoperability between the Air Force HAVE SYNC radio and the SINCGARS equipment being procured/developed by the other services.

6. (U) WORK PERFORMED BY: Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA, has program management responsibility. Magnavox Corporation, Ft Wayne, IN, is the prime contractor for HAVE QUICK, as well as HAVE QUICK II, and HAVE QUICK IIA (development). Cincinnati Electronics Corporation, Cincinnati, OH, is the prime contractor for the Air Force HAVE SYNC (airborne SINCGARS-V) with McDonnell Douglas Electronics Company, St Charles, MO, as a second source. The ground SINCGARS-V contractor is ITT, Ft Wayne, IN. The major support organizations include the MITRE Corporation, Bedford, MA (both projects); Electromagnetic Compatibility Analysis Center, Annapolis, MD (both projects); and the 3246th TW, Eglin AFB, FL (both projects).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) PROJECT: 2614, HAVE SYNC. The Army has development responsibility for a new family of Single Channel Ground and Airborne Radio System VHF (SINCGARS-V) radios. The SINCGARS-V Program will modernize current field VHF radios and provide an anti-jam, secure Electronic Counter-Countermeasures (ECCM) capability. The Air Force is planning to be interoperable with Army SINCGARS-V to accomplish close air support and other missions requiring multi-service coordination. This project allows Air Force participation in the Army SINCGARS-V Program and provides the engineering development required to integrate the SINCGARS-V capability into tactical aircraft via a form, fit, function ($F^3$) replacement (i.e., HAVE SYNC) for the AN/ARC-186 VHF Amplitude Modulated/Frequency Modulated airborne radio. This effort insures Air Force interoperability with Army, Navy, Marine Corps and any other forces that may employ SINCGARS-V. Production funding in the program is included for procurement of Army-developed ground SINCGARS-V radios as well as procurement of the Air Force-developed (HAVE SYNC) airborne radios and electronically tuned antennas required for aircraft applications. In FY 1987 the program continued FSD of the HAVE SYNC radio, including incorporation of provisions for later addition of embedded communications security (COMSEC). FSD activities to be accomplished in FY 1988 include qualification testing of engineering hardware and planning for Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E). The testing effort (DT&E/IOT&E) will be accomplished and FSD will be completed in FY 1989. Procurement of ground SINCGARS radios from the Army (via an existing Army contract) will be initiated in FY 1990. Procurement of the Air Force-developed HAVE SYNC radios will also begin in FY 1990.

B. (U) PROJECT: 2982 HAVE QUICK II. HAVE QUICK is a slow frequency hopping Ultra High Frequency radio which is providing near-term anti-jam (AJ) voice communications. HAVE QUICK vulnerabilities were assessed, and a program named HAVE QUICK II was initiated to develop and implement operational enhancements and performance improvements required to meet the evolving threat. Improvements include an increase in the number of frequencies over which the system can hop, an increase in the modulation factor, expansion of time dissemination methods, an increase in the number of preset frequencies, provisions for multiple and automatic Word-of-Day entry (new control head) and the incorporation of new software to optimize co-site (multiple radios operating simultaneously on the same platform) performance. Other key

improvements include raising the output power (to 20 watts) and increasing the hopping rate/providing for finer frequency resolution (nicknamed HAVE QUICK IIA), providing for HAVE QUICK/Global Positioning System time interfaces and the addition of electrical and mechanical provisions for later incorporation of an embedded communications security (COMSEC) capability. In 1987 the program began delivery of expanded memory boards to field units for installation into HAVE QUICK radios. Development of HAVE QUICK IIA (fast frequency hopping capability) was initiated as was development of a 100 watt high power amplifier. A procurement contract for new (electronic) control heads was also awarded. FSD activities to be accomplished in FY 1988 include continuation of the HAVE QUICK IIA and high power amplifier development efforts as well as the incorporation of provisions for embedded COMSEC in HAVE QUICK. Production of expanded memory boards and electronic control heads will continue. In 1989, development of HAVE QUICK IIA will be completed and procurement of these radios will begin. Fielding of expanded memory boards will continue and development of the 100 watt power amplifier will be completed.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: #0207435F (0207431F) (0604751F)
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Tactical Reconnaissance Imagery and Exploitation
Budget Avtivity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 803 | 1,138 | 1,532 | 0 | 11,862 |
| 2387 | Intra-theater Imagery Transmission System (IITS) | 705 | 1,138 | 1,532 | 0 | 5,339 |
| 3068 | Joint Service Imagery Processing System* | 98 | 0 | 0 | 0 | 6,532 |

*Beginning in FY 1988, RDT&E funds from PE 0207217F will be used to continue this effort. Procurement funds from PE 0207435F will be used to procure the developed systems beginning in FY 1990. Details of the current and follow-on objectives are in the PE 0207217F Descriptive Summary.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Tactical forces currently have to receive, process, exploit and disseminate critical imagery from various collection platforms. This program develops and procures ground-based imagery receipt, processing, exploitation and dissemination systems for fixed and deployed tactical forces.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 803 | 1,142 | 1,534 | 0 | 11,868 |
| Other Procurement | 12,349 | 0 | 0 | Continuing | N/A |

EXPLANATION: (U) Reduction in FY 1987 Other Procurement funds was done to correct an FY 1986 directed restructure of the IITS program (under the Imagery Transmission Procurement Line) which was inadvertently applied against the FY 1987 Information Transmission Procurement Line. Correction was made during the FY 1987 Procurement Authorization.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | 8,255 | 0 | 0 | 0 | 18,307 |
| Intra-theater Imagery Transmission System (IITS) | | | | | |
| Funds | 8,255 | 0 | 0 | 0 | 18,307 |
| Quantities | (8 ) | (0) | (0) | (0) | (81) |

5. RELATED ACTIVITIES: An IITS terminal consists of a Tactical Digital Facsimile (TDF, the imagery digitizer) integrated with an Interface Processor for Imagery Exchange (IPIX, the communication processor). The TDF was initially developed under a Navy lead and was contained in PE 0208010F (Joint Tactical Communications Program). The IPIX is also being integrated into the Joint Service Imagery Processing System (JSIPS), PE 0207217F (Advanced Tactical Air Reconnaissance System, ATARS), for secondary (exploited/annotated) imagery dissemination. In addition to the Air Force, Marine Corps and Army also participate in JSIPS. The secondary imagery dissemination role of IITS will also provide capabilities to the following imagery related PEs: 0604756F (Side Looking Airborne Radar), 0207215F (TR-1 Squadrons) and

6. (U) WORK PERFORMED BY: Program management for the IITS program is provided by Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. Technical engineering management support is provided by the MITRE Corporation, Bedford, MA. Litton-Amecon Corporation, College Park, MD, is the contractor for the TDF transceiver. General Electric, Automated Systems Division, Burlington, MA, is the contractor for the IPIX communication/support processor.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2387, IITS

A. Project Description: The Air Force currently has to transmit high priority, secondary (exploited/annotated) imagery to operational users. IITS is designed to fix this shortfall by providing for the secure, rapid transmission of secondary imagery. IITS will be capable of transmitting over the Defense Data Network, Joint Tactical Communications Program, Public Subscriber Telephone Network and dedicated lines. The imagery will be transmitted to tactical command and control centers, mission planners, aircrews and intel-

ligence analysts. The Intra-theater Imagery Transmission System (IITS) will greatly improve the delivery of time sensitive imagery and will relieve aircraft and crews from courier duty. Timely imagery support will significantly enhance pre- and post-mission planning, target/ordnance selection, analysis and aircrew target orientation.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The Tactical Digital Facsimile (TDF) began first article testing in December 1986. The Interface Processor for Imagery Exchange (IPIX) Request for Proposal was released in November 1986, and the contract awarded in June 1987.

(2) (U) FY 1988 Program: First article testing of the TDF will end in June 1988, and the production decision made in August 1988. The IPIX Preliminary Design Review and Critical Design Review will be accomplished and a production decision made by May 1988. Seven IPIX engineering development models will be delivered to Air Force Systems Command, Electronic Systems Division for testing and evaluation. After engineering tests, Follow-on Operational Test and Evaluation of IITS (integrated TDF and IPIX) will be accomplished.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Production of the TDFs will continue. Production of the IPIX will begin. Delivery of both the TDF and IPIX will begin in the second quarter FY 1989. The TDF and IPIX will be integrated/installed in the field to create an IITS terminal. All systems should be fielded by by mid FY 1990. FY 1989 RDT&E funds will be used to provide technical engineering support and installation. Cost estimates for this program are Category III.

(4) (U) Program to Completion: Installation and integration of all IITS terminals should be completed by mid FY 1990.

C. (U) Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| (1) | (U) | TDF Contract Award | September 1984 |
| (2) | (U) | TDF First Article Testing Begin | December 1986 |
| (3) | (U) | TDF First Article Testing End | June 1988 |
| (4) | (U) | TDF Production Decision | August 1988 |
| (5) | (U) | IPIX Contract Award | June 1987 |
| (6) | (U) | IPIX Production Decision | May 1988 |
| (7) | (U) | IPIX First Article Testing Begin | August 1988 |
| (8) | (U) | IPIX First Article Testing End | October 1988 |

C. (U) Major Milestones (cont):

| Milestones | Dates |
|---|---|
| (9) (U) Tactical Digital Facsimile (TDF)/Interface Processor for Imagery Exchange (IPIX) Operational Test and Evaluation | November 1988 |
| (10) (U) TDF/IPIX Initial Operational Capability | March 1989 |
| (11) (U) TDF/IPIX Full Operational Capability | March 1990 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0208010F — Title: Joint Tactical Communications Program (TRI-TAC)
DOD Mission Area: 345 - Tactical Communications — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 6,975 | 9,961 | 4,298 | Continuing | N/A |
| 2260 | Communications Nodal Control Element | 1,200 | 1,000 | 0 | 0 | 153,400 |
| 2266 | Digital Troposcatter Terminal | 4,820 | 8,500 | 0 | 0 | 64,000 |
| 2270 | Support and Integration | 955 | 461 | 4,298 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The TRI-TAC program develops digital communications equipment for tactical operations. The Air Force needs to replace the aging and outdated equipment now in use with a secure, anti-jam communications network. Equipment developments include transmission and switching equipment, system control facilities, local distribution equipment, terminal devices, and interface equipment. The Air Force part of this joint development includes the Digital Troposcatter Terminal (TROPO) and Communications Nodal Control Equipment (CNCE). Significant slips and program cancellations to TRI-TAC due to budgetary constraints have increased the need to integrate more TRI-TAC capabilities into older generation equipments to improve interoperability during the transition period to TRI-TAC.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 6,975 | 15,872 | 8,102 | Continuing | N/A |
| Other Procurement | 151,411 | 176,766 | 210,537 | Continuing | N/A |

EXPLANATION: (U) RDT&E: Changes in RDT&E FY 1988 are due to Congressional reductions. The Tactical Generic Cable Replacement development was cancelled, acquisition strategy for the Electromagnetic Counter-Countermeasures (ECCM) was reduced to allow a competitive contractor "best effort" in developing a prototype brassboard. The $3.8 Million RDT&E reduction in FY 1989 is due to elimination of funding requested for the ECCM development program due to budgetary limitations. The program will be indefinitely postponed. FY 1988/89 Other Procurement changes are due to Congressional and general program reductions. Several TRI-TAC circuit switch programs were cancelled and AN/TRC-170 Troposcatter Radio and Single Subscriber Terminal production was accelerated.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement* Funds | 151,411 | 151,000 | 153,037 | Continuing | N/A |

* These funds are for the procurement of numerous items of TRI-TAC equipment and are not identified by project but apply to entire Program Element.

5. (U) RELATED ACTIVITIES: Work under Program Element 0208010F is conducted by all Services under the overall direction of the Office of Assistant Secretary of Defense, Command, Control, Communications ($C^3$) and Intelligence, and the guidance of the Joint Tactical $C^3$ Agency, Ft Monmouth, NJ. Developments and interfaces of tactical communications systems are coordinated within this program element. The objective is to ensure sufficient coordination to prevent duplication of effort and to permit standardization of interfaces. The program also interfaces with the Tactical Air Control System Improvement Program, PE 0207412F, through a bilateral working group.

6. (U) WORK PERFORMED BY: The Air Force Systems Command managed the Air Force portion of this program through the Electronic Systems Division. Hanscom AFB, MA. Current contractors include: Martin-Marietta Corporation, Orlando, FL, Communications Nodal Control Element (CNCE); Raytheon Company, Sudbury, MA, Unisys Corporation, Salt Lake City, UT, and Signatron Corporation, Lexington MA, Troposcatter Radio (TROPO); Sonicraft Corporation, Chicago Il, TAC-1 Fiber Optics Interface Unit; Analytical Systems Engineering Corporation, Burlington, MA, and MITRE Corporation, Bedford, MA, System Engineering Support.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2270, Support and Integration.

A. (U) Project Description: This project provides for the integrated planning and system manuals required to incorporate the new digital systems into the current inventory as the various TRI-TAC equipments are fielded. Deliveries occur over several years. Also included are Air Force support equipment, manuals, Engineering Change Proposals (ECPs) and software upgrades for equipment developed by other services; interface equipment; Air Force peculiar Initial Operational Test and Evaluation; and basic level-of-effort program office support. Integration and support efforts continue throughout the program as new systems are fielded. Funding is related to production deliveries and based on experience with equipments already fielded.

(1) (U) FY 1987 Accomplishments: Major tasks included support for fielding AN/TRC-170 troposcatter radios and the Communications Nodal Control Element. The CNCE Follow-On Operational Test and Evaluation was

conducted and support continued for fielding of AN/TRC-170 Troposcatter Radios to Korean, Europe and Conus location. Investigation was initiated on low cost alternatives to the cancelled Modular Tactical Communications Center. Work continued on revising the Air Force Planning and Engineering Guide, Air Force TRI-TAC's principal system manual. Development concluded on a prototype maintenance van to support combat communications teams. Work continued on prototype software development for the Tactical Automated Planning and Engineering System (TAPES), a computer program to assist communications planners in configuring tactical switches. Support continued in development of the Air Force Deployable Communications System Architecture and support to the Joint Tactical Command/Control/Communciations Agency ($JTC^3A$).

(2) (U) FY 1988 Program: Support for the above efforts will continue. New integration tasks will include the incorporation of TRI-TAC Single Subscriber Terminal into the older TGC-27/28 message van systems, integration of TRI-TAC equipments into the Air Support Operations Center (ASOC) vans and support to $JTC^3A$ development of a joint fiber optics interface standard.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Integration support for above tasks will continue in FY 1989. Software development for TAPES supporting the newer TTC-39A circuit switch will be initiated, engineering drawings and planning manuals will be developed for TRI-TAC integration into the ASOC, and software upgrades for fielded equipments will be funded.

C. (U) Major Milestones: Not applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

Budget Activity: 4, Tactical Programs AS OF: January 1988
Program Element: 0208010F, Joint Tactical Communications (TRI-TAC)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Joint Tactical Communications (TRI-TAC) program is a joint program with each service and National Security Agency responsible for the development of assigned equipment, including DT&E. The Air Force has been assigned the Communications Nodal Control Element (CNCE), Digital Troposcatter Radio (AN/TRC-170), and the Digital Nonsecure Voice Terminal (DNVT). Development testing of these equipments has been completed. DT&E included hardware integration testing, communications security, integration, reliability and maintainability, and acceptance testing of peripheral equipment. Follow-on Operational Test and Evaluation (FOT&E) was completed in April 1987. The contractor for the CNCE is Martin-Marietta, Orlando FL. The Raytheon Co., Sudbury, MA and the Unisys Co., Salt Lake, UT are the prime contractors for the AN/TRC-170. The contractor for the DNVT is General Atronics Corp, Philadelphia, PA. Follow-on competitive production of the DNVT is planned. These equipments are presently in production.

2. (U) Operational Test and Evaluation: TRI-TAC equipment is used by the Army, Air Force and Marine Corps for much or all of their tactical communications. The systems provides point-to-point transmission gear, message and circuit switches, control elements, multiplexers and terminal devices. For the Air Force, TRI-TAC equipment will be used to provide tactical communications to the Tactical Air Control System (TACS) and to the Combat Information System Groups (CISG). As its name suggests, the CNCE provided technical control to either the TACS or CISGs, through a series of control nodes.

(U) The CNCE has to interface with the transmission system, switches and a variety of terminals. All internodal trunking groups (point to point long-haul transmission) and dedicated circuits (i.e., long locals, local subscribers) will transverse the CNCE. The CNCE will also be required to interface with all external communications networks, including the Defense Communications Systems, commercial systems and other unique communications systems.

(U) The FOT&E of the Communications Nodal Control Element (CNCE) was managed by the Air Force Operation Test and Evaluation Center (AFOTEC). FOT&E was conducted by AFOTEC on three production CNCEs from 29 January to 7 April 1987. Although the CNCE has made great strides in meeting operational requirements since IOT&E, there is still work to be done before the using commands can use CNCEs--reliabily--in tactical communications networks. Overall, the CNCE was ated marginal in operational effectiveness and unsatisfactory in operational suitability. With improved technical data, intensive proficiency training for personnel, and improved reliability, the CNCE could offer major commands a much improved communications control system that meets operational requirements. Additional operational testing of areas rated less than satisfactory will be managed by the Air Force Communications Command.

(U) Pertinent Operational Test Reports: AFOTEC Air Force Evaluation Report for the TRI-TAC AN/TSQ-111 CNCE dated January 1982. AFOTEC TRI-TAC AN/TRC-170 (V) Tropo IOT&E Report dated December 1980. AFOTEC report Air Force Evaluation Report for the TRI-TAC TAC-954(V)1/TT. AFOTEC Air Force Evaluation Report for the TRI-TAC TA-954(V)/TT and TA-984(V)2/TT ECI DNVT dated May 1982. AFOTEC TRI-TAC Communications Nodal Control Element (CNCE) AN/TSQ-111 FOT&E Final Report dated May 1987.

Budget Activity: 4, Tactical Programs
Program Element: 0208010F, Joint Tactical Communications (TRI-TAC)

3. (U) System Characteristics:

| CHARACTERISTICS | OBJECTIVE/THRESHOLD | DEMONSTRATED |
|---|---|---|
| **Communications Nodal Control element:** | | |
| Digital Groups | | |
| Type I | 48 | 48 |
| Type II | 480 | 480 |
| Analog Channels | | |
| Type I | 24 | 24 |
| Type II | 144 | 144 |
| Transmission Rates | | |
| Analog | 4-108 HZ | 4-108 HZ |
| Digital | 0-19.2 MB/s | 0-19.2 MB/s |
| **Troposcatter Radio:** | | |
| Power | | |
| Type 1 | 10 Kilowatts | 10 Kilowatts |
| Type 2 | 1.5 Kilowatts | 1.5 Kilowatts |
| Type 3 | .66 Kilowatts | .66 Kilowatts |
| Range | | |
| Type 1 | 200 Miles | 200 Miles |
| Type 2 | 150 Miles | 150 Miles |
| Type 3 | 100 Miles | 100 Miles |
| Capacity (Digital Channels) | 60 | 60 |
| **Digital Nonsecure Voice Terminal:** | | |
| Range | 4-8 KM | 4-8 KM |
| Weight | 6 Lbs | 6 Lbs |
| Rate | 16/32 KB/s | 16/32 KB/s |

Budget Activity: 4, Tactical Programs
Program Element: 0208010F, Joint Tactical Communications (TRI-TAC)

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months):

| EVENT | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| Communications Nodal Control Element (CNCE) FOT&E | 5 Jan 87 | 29 Jan 87 | |

T&E Activity (Next 12 Months):

| EVENT | Planned Activity | Remarks |
|---|---|---|
| CNCE Operational Testing | To Be Scheduled | Air Force Communications Command testing is planned to be conducted in conjunction with an operational exercise |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303605F
DOD Mission Area: 333 - Strategic Communications

Title: Satellite Communications (SATCOM) Terminals
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 4,461 | 13,946 | 17,994 | Continuing | N/A |
| 3163 | UHF Satellite Terminal System (USTS) | 3,600 | 6,800 | 5,000 | 500 | 16,200 |
| 3164 | Ground Mobile Forces Terminals (GMFT) | 861 | 200 | 5,000 | Continuing | N/A |
| 3594 | Universal SHF Satellite Communications Modem | 0* | 6,946 | 7,994 | Continuing | N/A |

* Approximately $8,500 was transferred from DCA, PE 0303126K.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Ultra High Frequency (UHF) Satellite Terminal System (USTS) program, formerly the Military Airlift Command (MAC) UHF Satellite Terminal (MUST), (Project 3163) will develop a small UHF satellite communications terminal which will operate in either the airborne or ground mobile mode to support MAC and other Air Force communications requirements. These terminals will permit more effective military operations by providing Air Force users with a flexible, reliable, and secure worldwide Command and Control (C2) system using UHF satellites. The USTS terminal will also provide interoperable modes with the Navy developed UHF satellite systems. The Ground Mobile Forces Terminals (GMFT) program (Project 3164) is a program to develop a family of tactical satellite communications terminals to support tactical ground forces. The Air Force requirements in the GMFT program include development of transportable network control capability and small (man-transportable and para-droppable) Extremely High Frequency and Super High Frequency (SHF) tactical satellite terminals to meet requirements of Special Operations Forces, MAC Combat Control Teams and elements of the Tactical Air Control System. The Universal SHF Satellite Communications Modem (Project 3594) will develop an interoperable, anti-jam, nuclear-capable modem for use in all SHF terminals that use the Defense Satellite Communications System (DSCS) satellites. The modem will provide interoperability among the strategic and tactical elements of all the military services. Additionally, a Memorandum of Understanding is being negotiated to establish a joint program with the United Kingdom.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 4,461 | 23,783 | 22,760 | Continuing | N/A |
| Other Procurement | 0 | 0 | 16,732 | Continuing | N/A |

EXPLANATION: The Office of the Secretary of Defense transferred responsibility/funding for development of the Universal Super High Frequency modem from the Defense Communications Agency to the Air Force. A $9.8 million reduction in FY 1988 to the Program Element was a result of Congressional action. The UHF Satellite Terminals System program required an increase based on actual contract cost. The FY 1988 estimate was prepared prior to the source selection process. Accurate costs could not be used to update the FY 1988/1989 submission as they were scurce selection sensitive. The Ground Forces Terminals program was increased in FY 1989 by $2.6 million from USTS Other Procurement funds and the UHF Satellite Terminals program was increased by $5.0 million in FY 1989 from USTS Other Procurement funds. The Universal Modem effort reduced by $16.4 million by the Air Force, but subsequently increased by the Office of the Secretary of Defense by $4.0 million in FY 1989, through a Program Budget Decision. The Air Force also found it necessary to reduce USTS Other Procurement Funding by $5.9 in FY89 to meet budget objectives.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds (USTS only) | 0 | 0 | 2,300 | Continuing | N/A |
| Quantities (USTS) | 0 | 0 | 10 | | |

5. (U) RELATED ACTIVITIES: Prior to FY 1985, funding for Military Airlift Command (MAC) Command and Control (C2) Upgrades was programmed in PE 0401840F (MAC C2 Upgrades). Beginning in FY 1985, the satellite terminal development and acquisition portion of the MAC upgrades was transferred to PE 0303605F. Other portion of the MAC C2 upgrades remain in PE 0401840F. In the Ground Mobile Forces Terminals program, the Army's Satellite Communications Agency (CECOM) acts as contracting agent for the Air Force terminals. Air Force Systems Command's Electronic Systems Division works with the Army to insure development of equipment that meets Air Force requirements and is interoperable with equipment developed for the Army and other Services. The Defense Communications Agency (DCA) initiated the Universal SHF modem definition under PE 0303126K, and will remain responsible for overall systems integration.

6. (U) WORK PERFORMED BY: Electronic Systems Division (Air Force Systems Command), Hanscom Air Force Base, MA, provides overall program management for the projects. Currently, MITRE Corporation, Bedford, MA, is assisting Electronic Systems Division in performing studies and technology assessments. Request for Proposals for the UHF Satellite Terminal System (USTS) was released in June 1986. Under the Army Single Channel Objective Tactical Terminal (SCOTT) program, Magnavox Ashburn, VA and Raytheon Bedford, MA as a team received a Full Scale Development contract in December 1985.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3163, UHF Satellite Terminal System (USTS). Military Airlift Command and other Air Force users require highly mobile satellite terminals for airborne and ground applications. These terminals will be configured with Demand Assigned Multiple Access (DAMA) equipment to allow maximum efficient use of the Ultra High Frequency (UHF) satellites. Without DAMA equipment being built into the terminal, future UHF satellite capacity will not be able to support total mission requirements. Demand Assigned Multiple Access equipment allows a dramatic increase in service to users by sharing of capacity on an as-needed basis and then only for the time actually required to pass information. The DAMA capability will be adopted as the DOD standard for 5KHz UHF satellite communications and will provide full interoperability with the Navy developed 25KHz UHF satellite DAMA capability. FY 1987 through FY 1989 funds development of the equipment with completion in FY 1989.

B. (U) Project: 3164, Ground Mobile Forces Terminals (GMFT). The Air Force is currently fielding Multi-Channel Super High Frequency (SHF) transportable satellite terminals for the Tactical Air Control System and Combat Communications forces. These terminals will be retrofitted with the Army developed Anti-Jam Control Modem (AJCM), providing full interoperability among tactical Super High Frequency satellite terminals. The Air Force requires a small, lightweight satellite communications terminal to provide survivable, secure voice and data for highly mobile combat teams such as Forward Air Controllers, Special Operations Forces, and Military Airlift Command (MAC) Combat Control Teams. This project develops lightweight satellite ground terminals which can be transported by a team of personnel or be paradropped with the team. The terminals will use the Super High Frequency (SHF) technology developed under the Army programs such as Ground Mobile Forces Satellite Communications program. The FY 1987 program funded further study of requirements. FY 1988 and FY 1989 fund the integration of the Anti-Jam Control Modem into the Air Force Super High Frequency satellite terminals and the formulation of manpack satellite terminal standards and evaluation of communication protocols for operating and controlling satellite networks.

C. (U) Project: 3594, Universal SHF Satellite Communications Modem. Develops and acquires a brassboard prototype with FY 87 through 89 funds. The original program objective, provide by the Assistant Secretary of Defense for Command, Control, Communications and Intelligence, in response to congressional mandates was to provide strategic and tactical inter operability and support all data rate communications in a hostile, electromagnetic and nuclear effects environment. The Assistant Secretary of Defense for Command, Control, Communictaions and Intelligence designated this a high priority and urgent program requiring accelerated development. Fiscal realities have forced the Air Force, with other Services and the Joint Staff concurrence, to focus on completion of the brassboard waveform development. This take advantage of the investment already made and provide a demonstrated waveform to be approved as a DOD standard.

(U) In Sep 87 a contract for the brassboard development was awarded. Negotiations will be completed and an MOU signed between the U.S. and United Kingdom, establishing a joint program and United Kingdom funding arrangements. The acquisition strategy has several competing Leader/Follower teams with downselection at the end of the brassboard phase, prior to entering Full Scale Development, should that be approved. Preplanned Product Improvement efforts will no longer be pursued as funds are not available. The Category IV, planning cost, estimates were developed by the Defense Communications Agency's program office. Those FY88 and FY89 funds still remaining will slow down but allow completion of the critical Brassboard Phase. If funds were made available, Full Scale Development would begin in FY 1990 with completion in FY 1991 to include development/operational testing. Satisfactory results will lead to initiation of production, pending funding availability. Each Service would provide procurement funds for its own requirements.

8. (U) COOPERATIVE AGREEMENTS: The Universal Modem program is planned as a codevelopment effort with the United Kingdom's Ministry of Defence. A Memorandum of Understanding is in work with the UK detailing arrangements. Current plans are for the UK to provide a proportional share of the development costs and for teaming of US and UK contractors.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0401840F
DOD Mission Area: 356 - Mobility

Title: Military Airlift Command (MAC) Command & Control System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Addtional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 11,594 | 7,969 | 9,015 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: There is a significant airlift shortfall in support of all major operations plans. In order for the Military Airlift Command (MAC) to make optimum use of its scarce airlift resources, it must rapidly exchange vital command and control ($C^2$) information between ground elements and airlift aircraft on a global basis. MAC's present capability, based on 1960s equipment, is seriously inadequate. MAC's command and control components must be upgraded into a coordinated, integrated system as detailed in the MAC $C^2$ Architecture Implementation Plan, written in June 1982. This program addresses three elements of that architecture by upgrading MAC's command centers, developing and procuring information processing support equipment, and developing a survivable, secure communications capability for all MAC echelons.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 10,534 | 10,002 | 11,015 | Continuing | N/A |
| Aircraft Procurement | 0 | 0 | 24,785 | Continuing | N/A |
| Other Procurement | 3,408 | 15,299 | 28,620 | Continuing | N/A |

EXPLANATION:

RDT&E (U) FY 1988 decrease due to Congressional reduction and movement of Special Operation Forces funds ($494 thousand) from this PE to PE 111011F. FY 1989 reduction due to movement of Special Operation Forces funds to PE 111011F.

Procurement (U) The FY 1987 and FY 1988 decreases are due to Congressional reductions. The FY 1989 decrease is due to Air Force reprogramming to higher priority programs. The number of automatic communications processors purchased in FY 1989 will be reduced with a resulting unit cost increase.

4. (U) OTHER APPROPRIATION FUNDS: (in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement* | | | | | |
| Funds | 0 | 0 | 23,000 | Continuing | N/A |
| Quantities | Not Applicable | | | | |

Program Element: 0401840F
DOD Mission Area: 356 - Mobility

Title: Military Airlift Command (MAC) Command & Control System
Budget Activity: 4 - Tactical Programs

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement* Funds | 2,808 | 10,600 | 14,159 | Continuing | N/A |

* Only that portion of the total procurement funding in PE 0401840F dedicated to the Automatic Communications Processor and the Information Processing System is shown above.

5. (U) RELATED ACTIVITIES: RDT&E funding for Ultra High Frequency (UHF) satellite terminals is in PE 0303605F, Satellite Communications Terminals.

6. (U) WORK PERFORMED BY: Air Force Systems Command's Electronic Systems Division (ESD), Hanscom AFB, MA, will provide overall program management. Contel Federal Systems, Fairfax, VA; Computer Science Corp., Moorestown, NJ; GTE Government Systems, Westboro, MA; and TRW Defense Systems, Redondo Beach, CA, were awarded Information Processing System (IPS) concept definition contracts. Rockwell-Collins, Cedar Rapids, IA, is developing the Automatic Communications Processor (ACP).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: NOT APPLICABLE

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 41840F, MAC Command and Control (C2) System

A. (U) Project Description: This project consists of two development programs to satisfy two essential elements of the MAC $C^2$ architecture validated in MAC Statement of Need 3-81. It develops and procures basic communications and information processing hardware and software for all echelons of the MAC $C^2$ system. The IPS will integrate new computer resources and software with improved High Frequency (HF) and new UHF satellite networks and other communications media into a unified MAC Command and Control System. A portion of IPS was accelerated and combined with procurement of other command post equipment to provide an immediate capability, the Global Decision Support System (GDSS). The GDSS, initiated as an unprogrammed, fast implementation task in response to a Joint Chiefs of Staff (JCS), Chief of Staff of the Air Force, Commander-in-Chief, Military Airlift Command (MAC) Memorandum of Understanding, was completed in FY 1987. The Automatic Communications Processor (ACP), formerly part of the Adaptive HF program, provides major improvements in HF radio communications through the development of the ACP. Features of the ACP will include anti-jam and address protection features as well as a new radio control head to improve performance of the conventional airborne radio (AN/ARC-190).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 effort consisted of three major development efforts. The IPS

specification and contractual documentation, evaluation of proposals, and source selection for contract definition phase were completed. Thia phase of the IPS work initiated the evolutionary acquisition process for the global $C^2$ systemthat will continue through FY 1994. The GDSS, initiated in FY 1985 was completed with FY 1987 funding, complying with the two year time frame requested in the implementing Memorandum of Understanding. Software development was completed and tested and all hardware and software were fully operational in September 1987. Full scale engineering development of the control head for the ACP was completed, and Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) of the ACP commenced which will lead to initial production decision (option) on 200 units in FY 1988. Completion of ACP development is key to a comprehensive MAC airlift modification program to incorporate the ACP in all airlift beginning in FY 1989.

(2) (U) FY 1988 Program: The IPS concept definition work will be completed and major software development and initial hardware procurement will begin. The ACP program will exercise the first production option for 200 units supporting ground and airborne applications. The aircraft ACP modification program will be initiated for C-130, C-141, and C-5 aircraft. The ACP cost estimate is category II based on sole source. The IPS cost estimate is category III, budgetary, based on contractor and program office estimates.updated May 1987.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Automatic Communications Processor (ACP) will continue production and installation in ground and airborne applications. The Information Processing System (IPS) will continue software development and coding (evolutionary) and the first units of IPS prime mission equipment will be acquired and installed. The ACP cost estimate is category II based on a sole source contract. The IPS cost estimate is category III, budgetary, based on contractor and program office estimates updated May 1987.

(4) (U) Program to Completion: This is a continuing program. The IPS will continue development and implementation. The IPS will be an evolutionary capability which, when the prototype system is initially fielded, will be analyzed, tested and enhanced to meet future requirements and to optimize its utility to MAC. The ACP will continue production and installation in ground and airborne applications.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Start ACP Developmental Testing | | January 1987 |
| (2) (U) IPS Final Request for Proposal (RFP) Release | | February 1987 |
| (3) (U) Start ACP Operational Testing | | August 1987 |
| (4) (U) ACP Production Option | *(1st Qtr FY 88) | 2nd Qtr FY 88 |
| (5) (U) Award IPS Implementation | *(1st Qtr FY 88) | 4th Qtr FY 88 |
| (6) (U) ACP Production Contract | | 3rd Qtr FY 89 |

*Date presented in FY 1988/89 Descriptive Summary

(U) Explanation of Milestone Changes

(4) (U) Two month slip due to test taking longer than planned.
(5) (U) Seven month slip due to concept definition process taking longer than planned.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0502610F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: A-7 Squadrons (ANG)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 37,318 | 59,965 | 83,288 | 35,018 | 214,588 |
| 3275 | A-7 Avionics Test Station Replacement | 3,000 | 6,145 | 9,546 | 5,809 | 24,500 |
| 3606 | A-7 Upgrade | 29,318 | 49,060 | 73,742 | 29,208 | 180,328 |
| 3661 | CAS Study | 5,000 | 4,760 | 0 | 0 | 9,760 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Project 3275 is a development effort that replaces the 20-year-old and severely degraded A-7 "Big Eight" intermediate level avionics test stations (analogous to F-16 avionics intermediate shop) with new modular automatic test equipment compliant test stations that will support the A-7 through the year 2010. The A-7 aircraft will be in service through the year 2010. The aging A-7 "Big Eight" testers are rapidly becoming logistically unsupportable and unreliable and are projected to be totally unsupportable by 1990. The new, deployable test stations will provide full diagnostic and repair capability for current and planned A-7 avionics at 20 continental United States locations.

(U) The A-7 Upgrade Program, project 3606, will provide for prototype of two A-7D aircraft which would be fitted with an augmented engine and aerodynamic improvements. This would require a stretch of the fuselage fore and aft. The end result would be a reprocurement data package to support a competitive production program.

(U) Project 3661 is for the Close Air Support study to investigate alternative designs for a possible replacement to the A-10 aircraft.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 36,138 | 63,220 | 83,367 | 35,017 | 217,742 |
| Aircraft Procurement | 0 | 0 | 0 | 0 | 0 |

EXPLANATION: (U) With a reduction of $328,000 in FY 88, the contract with Bendix will require renegotiation to delete three of the original ten Test Program Sets (TPS) previously scheduled for completion in this fiscal year. As a result, several A-7 aircraft line replaceable units will not have the capability to be tested on the new field test equipment and will be shipped to the vendor for repair. Each vendor will require a contract, and project 3275 will require additional program funds (cost estimate to be determined) in appropriation 3400 (Operations & Maintenance) to cover this expense.

(U) Project 3661 was initiated to study potential replacements to the A-10 aircraft. First flight test of project 3606 has been delayed 3 months, and deliverables will not provide full modification kit data due to the distributed reduction to this project.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds | | | | | |
| Project 3606 | | | | | |
| BP1100 | 0 | 10,000 | 0 | TBD | TBD |
| Project 3275 | | | | | |
| BP1200 | 0 | 13,200 | 41,200 | 65,000 | 119,400 |
| BP1600 | 0 | 600 | 1,700 | 2,700 | 5,000 |
| Quantities | (0) | (4) | (12) | (18) | (34) |
| Operation & Maintenance: | | | | | |
| Funds | (0) | 600 | 600 | 500 | 1,700 |

5. (U) RELATED ACTIVITIES: Not Applicable.

6. (U) WORK PERFORMED BY: Project 3275 (A-7 Avionics test stations Replacement Program) is on contract with Allied Bendix Corp., Teterboro, NJ. Project 3606 (A-7 Upgrade) is on contract with LTV Aerospace, Dallas, TX. Project 3661 (CAS study) is on contract with six selected airframe contractors: Boeing, Seattle, WA; General Dynamics, Fort Worth, TX; Lockheed, Marietta, GA; McDonnell Douglas, St. Louis, MO; Northrop, Hawthorne, CA; and Rockwell International, El Segundo, CA.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3275, A-7 Avionics Test Station Replacement The A-7 "Big Eight" testers, fielded in the early 1960s, are severely degraded in terms of accuracy and reliability due to the wear and tear of many years of service. The original contract service life of 2,000 operating hours has now exceeded 10,000 hours. The wiring is extremely

brittle and degraded through countless maintenance actions, and vendor parts are increasingly difficult or impossible to procure. For each hour of actual test time, approximately .65 man-hours are expended in calibration and repair of the old test equipment. Approximately 95% of the A-7 avionics line-replaceable unit repairs are accomplished using this equipment. This development effort will provide Modular Automatic Test Equipment (MATE) compliant, fully deployable test stations that will satisfy A-7 avionics diagnostic/repair requirements through the year 2010. The A-7 avionics to be supported include the inertial measurement unit, doppler navigation, head-up display, navigation-weapons delivery computer (mission computer), forward-looking radar, air data computer, and armament station control units, etc. The DT&E funds are required for one prototype set of test stations, development of software (both test station control and support software and avionics test software), development of interface test adapters peculiar to A-7 avionics, and operational test and evaluation. The FY 1987 RDT&E funds initiated full-scale development of (a) test station control and support software; (b) 26 of 45 TPS consisting of individual avionics test software, interface test adapters, and cables to support A-7 avionics systems listed previously; and (c) prototype test station hardware. Production funding in FY 1987 procured technical and engineering data. The FY 1988 program began full-scale development of prototype test station hardware plus control and support software with the contract award to Bendix Corp. In addition, full-scale development will be completed on 4 of the 45 TPSs required for performance and diagnostic testing of current A-7 D/K avionics Line Replaceable Units (LRUs). Production funding provides production tooling and long-lead manufacturing items and will continue through FY 1991 to provide replacement test stations to fully satisfy test requirements at 14 Air National Guard (ANG) bases; Nellis AFB (Tactical Air Command); Edwards Flight Test Center (Air Force Systems Command); Neward AFS (Aerospace Guidance and Methodology Center); and three Air Logistics Centers. The estimate category is IV, Planning, based upon previous experience with development of MATE compliant test stations for intermediate and depot level maintenance on B-52 Strategic Radar, Electro-Optical Viewing System and Offensive Avionics systems. The cost estimating technique used was parametric and assumed a competitive procurement. The last comprehensive review of the cost estimate by the program office was January 1986. The FY 1989 program will deliver a prototype test station, hardware and control software for development test & evaluation testing in the contractor's facility, plus complete development of another 16 TPS. Systems compatibility testing and field operational test & evaluation will be initiated. Two production test systems will be delivered to the Air Force. Cost estimate category is IV based on previous experience with development of the MATE compliant test stations utilized on B-52 strategic radar upgrade. The FY 1990 RDT&E funds will be required to complete development of the remaining 13 TPS for a total of 39. Operational test & evaluation will be completed and initial operational capability declared. The remaining 32 production test systems, including all associated TPS, will be delivered in FY 1990 and FY 1991.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3606, A-7 Upgrade

A. (U) Project Description: The A-7 Upgrade is a program to modernize the current A-7D and K models of aircraft. The Air Force needs a Close Air Support/Battlefield Air Interdiction (CAS/BAI) aircraft to support the Army's Air-Land Battle doctrine. The current A-7 is tasked with CAS/BAI missions and is rapidly becoming obsolete and increasingly vulnerable to the increasing threat. The modified A-7 Upgrade is a cost-effective solution to the need for a CAS/BAI aircraft. It has high payload/range, speed maneuverability, and reliability and can operate from short fields, under the weather, day or night, and achieve first-pass target destruction. Mobility requirements are reduced by 53%, or from

19 to 9 C-141B aircraft equivalents, and a 23% reduction in maintenance personnel. Improved systems reliability and maintainaLility would provide a maximum break rate of 10.5%, maintenance man-hours per flight hour of 15.6 and mission capable rate of 88%. The current engine would be replaced with an augmented engine. The engine bay would be configured. Approved and proposed airframe and avionics mods would be included in the final configuration of the aircraft. The approved mods are: Low Altitude Night Attack, Replacement Inertial Measurement System, Combined Altitude Radar Altimeter, Standard Combined Air Data Computer, and high reliability/maintenance free battery. The airframe mods are: Strakes, Augmented flaps, lift dump spoilers, Airframe Mounted Accessory Drive, 609 KVA generator, larger fuel lines, improved air conditioning system, on-board oxygen generating system, new wiring, Hands on Throttle and Stick, Data Transfer Module, improved com/nav control, and ALR-69. The RDT&E funds are required for two prototype aircraft and data packages.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 RDT&E funds initiated this prototype program by commencing funding for development of two modified A-7Ds.

(2) (U) FY 1988 Program: The FY 1988 RDT&E program continues the FY 1987 program and leads to production of two prototype aircraft and data packages. Avionics integration of all avionics mods will be completed and funded separately and are not part of this effort. First flight of prototype aircraft is 24 months after contract award.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 RDT&E Program continues the flight test of the two A-7Ds with an augmented engine, and associated airframe and aerodynamic modifications required to provide the desired handling qualities required. It will also include extensive data reduction and data package development. The costs are based on a fully negotiated sole source, firm fixed price contract for the limited prototype effort.

(4) (U) Program to Completion: The FY 1990 and FY 1991 RDT&E funds will be required to complete flight test for the prototype effort only.

C. (U) Major Milestones:

| Milestones | Date |
|---|---|
| (1) (U) Contract Award | May 1987 |
| (2) (U) First Flight | May 1989 |
| (3) (U) Production Decision | July 1989 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: #1110011F
DOD Mission Area: #207 - Special Operations Forces (SOF)

Title: SOF Force Enhancements - Active
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual* | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 116,837 | 155,263 | 391,518 | 764,216 |
| 3129 | MC-130H | 0 | 4,700 | 10,800 | 7,100 | 43,000 |
| 3174 | SOF Sensor Upgrade | 0 | 2,200 | 100 | 0 | 2,300 |
| 3284 | SOF Defensive Systems | 0 | 6,972 | 24,670 | 169,880 | 201,522 |
| 3326 | AC-130U | 0 | 67,297 | 64,700 | 70,500 | 259,537 |
| 3642 | AC/MC-130 Aircrew Training System | 0 | 3,500 | 27,950 | 70,500 | 101,950 |
| 3752 | CV-22A | 0 | 31,899 | 25,601 | 73,538 | 137,277 |
| 3753 | Integrated Digital Avionics | 0 | 269 | 453 | 0 | 17,641 |
| 3758 | SOF $C^2$ Upgrade | 0 | 0 | 989 | 0 | 989 |

*Funding prior to FY 1988 for MC-130H and AC-130U(PE 44011F), CV-22A(PE 63256F), Integrated Digital Avionics(PE 64219F), and SOF $C^2$ Upgrade(PE 41840F).

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A 1986 joint Air Force/Army analysis of worldwide SOF airlift requirements to meet 100% of the needs of the unified commanders-in-chief as well as the Joint Special Operations Command concluded that the minimum worldwide operational requirement for MC-130s was 56 of which 40 are needed in MC-130H configuration and 16 in MC-130E Tanker configuration. The results of this study formed the basis for the 1 April 1986 Secretary of Defense SOF Airlift Report submitted to Congress. This study and the Secretary's report also identified the need for 32 AC-130 Gunships. Subsequently the Defense Resource Board directed a joint study by the Joint Special Operations Agency and the Office of the Assistant Secretary of Defense for International Security Affairs with Service coordination to review SOF airlift requirements more realistically constrained like other mission areas. This review concluded that 14 MC-130E Tanker aircraft could be counted against both the tanker and the MC-130H requirement and therefore the number of new MC-130H aircraft required would be reduced to 24. This review also determined that retaining all AC-130 Gunships in the active component would reduce the number from 32 to 22. The 10 AC-130A Air Force Reserve (AFRES) aircraft will be retired incrementally as the new AC-130U aircraft become operational in the FY 1992 time period. This program element contains RDT&E and procurement funding required to procure 24 MC-130H Combat Talon II aircraft and 12 AC-130U Gunships. RDT&E funds are requested for development of the CV-22, which will provide the Air Force SOF with the ability to conduct long-range infiltration, resupply, and exfiltration missions requiring vertical/short takeoff and landing capabilities. RDT&E funds are also requested for SOF Sensor Upgrade (improvements to AC-130 40mm ammunition), SOF Defensive Systems (development of a common electronic warfare architecture for the entire SOF fleet), AC/MC-130 Aircrew Training System (weapon system trainer for MC-130H/AC-130U), Integrated Digital Avionics (reconfiguring the APQ-174 multi-function radar for the V-22), and SOF $C^2$ Upgrade (improved mission planning system).

Program Element: #1110011F　　Title: SOF Force Enhancements - Active
DOD Mission Area: #207- Special Operations Forces (SOF)　　Budget Activity: #4 - Tactical Programs

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 70,579 | 109,487 | 113,461 | 230,203 | 532,261 |
| Aircraft Procurement | 318,577 | 653,300 | 760,250 | 11,541 | 1,745,870 |

(U) EXPLANATION: RDT&E: FY 1987 was initially reduced by nonprejudicial Congressional action, subsequently increased by the FY 87 Supplemental Request which added funds needed for the planned SECDEF SOF airlift force, but eventually reduced when the FY 87 Supplemental Request was denied. The FY 1988 increase is due to a combination of Congressional reductions and the combined funds for CV-22A and Integrated Digital Avionics. The FY 1989, additional to completion, and total estimated cost increases reflect addition of these two programs and SOF $C^2$ Upgrade. Procurement: FY 1987 and 1988 decreases are due to Congressional reductions. The 1989, additional to completion, and total estimated cost increases are due to the one year funding delay of procurement for AC-130U as well as delay of completing MC-130H procurement beyond FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement (Project: 3129, MC-130H) | | | | | |
| Funds | 229,400 | 344,800 | 209,500 | 154,100 | 1,234,800 |
| Quantities | 5 | 7 | 4 | 2 | 24 |
| Aircraft Procurement (Project: 3326, AC-130U) | | | | | |
| Funds | 0 | 18,200 | 324,800 | 313,700 | 656,700 |
| Quantities | 0 | 0 | 6 | 5 | 11 |
| Military Construction (Project: 3129, MC-130H) | | | | | |
| Funds | 0 | 4,000 | 2,450 | 11,441 | 24,061 |
| Military Construction (Project: 332[illegible], AC-130U) | | | | | |
| Funds | 0 | 0 | 0 | 10,100 | 10,100 |
| Military Construction (Project: 3642, AC/MC-130 Training System) | | | | | |
| Funds | 0 | 0 | 4,600 | 0 | 4,600 |

5. (U) RELATED ACTIVITIES: The MC-130H Combat Talon II derives its basic avionics architecture from Program Element 64753F, Combat Helicopter Modernization (HH-60A) R&D program, which the Air Force cancelled. Common systems include software, displays, keyboard entry units, display electronics units, remote terminal units and forward looking infrared.

With the cancellation of the HH-60A program, the development, acquisition and support costs for the MC-130H program increased. Systems development previously programmed under the HH-60A program, but required also for the MC-130H, was funded under the MC-130H program. Regarding the CV-22A, the Air Force is a participating Service in the Navy-led V-22 program. Multi-function radar (MFR) development under the Integrated Digital Avionics program was incitiated in program element 64753F (Combat Helicopter Modernization). The Air Force and Navy versions of the V-22 both require MFR.

6. (U) WORK PERFORMED BY: All FY 1989 projects are managed by the Special Operations Forces System Program Office, (SOFSPO), Aeronautical Systems Division, Wright-Patterson AFB, OH. On 2 May 1986, the team of Bell Helicopter Textron, Ft. Worth, TX, and Boeing Vertol, Ridley Park, PA, was awarded the V-22 full scale development contract. The principal RDT&E agency is Naval Air Systems Command Washington, D.C. IBM Federal Systems Division, Owego, NY, is the avionics systems integrator for the MC-130H, CV-22A and multi-function radar (MFR) programs and Rockwell International is the integrator for the AC-130U. The C-130 airframes are procured from Lockheed Corporation, Marietta, GA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 3174, SOF Sensor Upgrade. This project provides for development of improved sensors and related munitions for special operations gunship (AC-130) applications. Visual sensors (low-light-level television and infrared) and electronic sensors require improvement to maintain the capability to support current tasking. A new laser target illumination system will be developed to meet the current operational need for precise target identification and greater weapons accuracy. This project was a FY 1987 new start and concentrated on munitions development for use with the AC-130 visual and electronic sensors as well as sensor development. The FY 1988 funds will continue development of the improved sensor systems and related munitions and provide for their test and evaluation. This program is in response to an identified combat deficiency (identified during Grenada) which prevented the Gunship from striking armored targets with munitions detectable by the aircraft sensors. The FY 1989 funds will be used to complete testing and evaluation required for production start.

B. (U) Project: 3753, Integrated Digital Avionics. This project expands the capability of the Low Altitude Navigation Targeting Infrared System for Night (LANTIRN) radar. Terrain avoidance, ground map, air-to-ground ranging, beacon, and weather modes will be added to the radar to enable the CV-22A to fly low level at night and in adverse weather conditions. The project conducted initial flight test of the radar on the HH-60 test bed and is developing software and hardware changes required for direct application on the V-22 for Navy combat rescue and Air Force SOF. FY 1989 funds are needed to prepare the radar for flight testing in the V-22 in FY 1990. The Navy will fund the actual flight test of the MFR.

C. (U) Project: 3758, SOF $C^2$ Upgrade. This project provides for the development of an improved mobile intel/mission planning system to support aircrew mission planning in a deployed environment and for development of Low Probability of Intercept communications equipment to support $C^2$ requirements in sensitive mission scenarios. This project is a FY 1989 new start and will concentrate on near-real-time intelligence information flow and develop a digital route survey capability to complement automated mission planning.

Program Element: #1110011F    Title: SOF Force Enhancements - Active
DOD Mission Area: #207 - Special Operations Forces (SOF)    Budget Activity: #4 - Tactical Programs

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3129, MC-130H.

A. (U) Project Description: This project provides for development of intermediate and depot-level peculiar support equipment (PSE) for those avionics systems previously common between the MC-130H and the HH-60A programs, and develops an integrated electronic warfare suite for the Combat Talon II. Interim contractor support is programmed to support MC-130H intermediate and depot-level support requirements during flight testing pending development and procurement of the required PSE. The program started in FY 1986 but was delayed by late release of FY 1986 funding.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Phase I of the MC-130H Combat Talon II Integrated Electronic Warfare (EW) Suite Study was completed. The study involved various Combat Talon II recommendations for EW integration enabling mission success in an increasingly sophisticated enemy threat. Initial intermediate level support equipment requirements were defined.

(2) (U) FY 1988 Program: Phase II will design and develop the SOF Integrated Defensive System (SIDS) for the Combat Talon II. SIDS maximizes existing aircraft capability for increased effectiveness and growth for new technologies. Additionally, this activity will form the foundation for the Avionics Software Integration Facility (ASIF) to missionize CT II and eventually all SOF Electronic Combat (EC) software and reprogramming requirements. Refinement of intermediate level support equipment continues. Surveys of support equipment are completed to determine minimal levels of RDT&E required to field a complete CT II system. Test set software development for aircraft avionics is initiated.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 effort will continue development and engineering of SIDS. Laboratory and integration testing of aircraft defensive avionics with the remaining aircraft avionics occurs in FY 1989. ASIF equipment required for SOF's missionization and support of SIDS will begin development. RDT&E of intermediate level support equipment will continue focusing on development of test set software for aircraft avionics and defensive suite.

(4) (U) Program to Completion: FY 1990 through 1991 will provide for the beginning of the prototype development and testing for SIDS. Delivery of a software and reprogramming capability to missionize CT II EW will be completed. Intermediate level support equipment (hardware and software) will be available to support CT II and have application to other common SOF equipped aircraft.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) SIDS Proposal | March 1988 |
| (2) (U) SIDS Contract (ECP) Award | June 1988 |
| (3) (U) MC-130H Prototype and Test Complete | October 1990 |

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3284, SOF Defensive Systems.

A. (U) Project Description: This program provides funds for requirements definition, development, test, and evaluation of electronic warfare equipment, other systems, and an integrated maintenance support system. The results of this program will identify hardware for each SOF aircraft that will reduce vulnerability, detectability, and threat engagement by increasing the overall survivability of Air Force SOF assets. The initial efforts will focus on determining aircraft defensive requirements in 1986 and 1996 based on representative mission profiles and threat environments Once requirements are defined, development of an interactive defensive system with a common architecture and essentially common components will occur for the entire SOF fleet: AC-130H, AC-130U, MC-130E, MC-130H, MH-53J, MH-60G, HC-130P/N, C-141B Special Operations Low Level (SOLL) II, C-130E SOLL II, and CV-22A. The interactive defensive system concept will combine information from sensors with stored information covering terrain, mission route, threat location and threat capability. It will incorporate existing and modified electronic, infrared, missile, and expendable countermeasures equipment into an interactive suite that will use stored terrain, route and threat data to provide precise threat infomation to the crew. Additionally, the appropriate on-board threat countering systems and receivers will communicate between themselves in order to perform more accurately and timely while in a threat environment. This type of information will include far more precise details than are available from current non-integrated or non-interactive systems. The crew will receive instant warnings and advice on the need to counter and/or avoid a specific threat(s) and alternative measures that could be employed. This project will also provide for later development of passive terrain following and terrain avoidance systems for Combat Talons and Gunships to reduce detection, enhance munitions, and improve high-speed airdrop systems to reduce vulnerability. Finally, an integrated maintenance concept support plan for the interactive defensive suite will be provided. This plan will be tailored to the SOF mission requirements and will consider factors such as mission readiness, deployment limitations, software reprogramming, spares and support pipelines, vertical testability, and organic depot capabilities and requirements.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable.

(2) (U) FY 1988 Program: The FY 1988 funds provide the initial modeling of mission threats using representative mission profiles to define aircraft requirements. This assessment provides recommended candidate subsystems that

will drive the development of an interactive architecture necessary to optimize the characteristics of a core ECM suite. Groundwork for initial development of the common architecture and system analysis to provide interactiveness will occur in 1988. An integrated maintenance support concept is being defined to increase commonality and reduce costs. These funds begin the integrated survivability system development for the MC-130H Combat Talon II. The scope and costs of this effort are being defined under the MC-130H procurement program.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 effort will continue development of the common architecture and the systems integration facility. Additional development allowing cross-communication (interaction) between previously stand-alone systems will occur. These efforts for the MC-130H, initial prototyping aircraft, have direct application for the remaining SOF aircraft. Emphasis will be placed on increased situation awareness through passive threat avoidance, near-real-time electronic intelligence and interactive defensive avionics to meet the 1996 anticipated threats.

(4) (U) Program to Completion: FY 1990 and beyond RDT&E funds will complete development and testing of the prototype interactive defensive avionics system for each SOF aircraft. Aircraft mission requirements determine avionics subsystem capabilities hosted by a common SOF architecture. Initial flight test and evaluation for the MC-130H will begin in FY 1991. Flight test and modification of the other SOF aircraft will begin during the same time period.

C. (U) Major Milestones:

| Milestones | Dates | |
|---|---|---|
| (1) (U) Core ECM Requirements Defined | *(July 1987) | July 1988 |
| (2) (U) RFP for Prototype Development Released | *(November 1987) | November 1988 |
| (3) (U) Source Selection Complete, Contract Award | *(April 1988) | April 1989 |
| (4) (U) MC-130H Prototype Flight Test Complete | *(November 1991) | November 1992 |
| (5) (U) First USAF Delivery (MC-130H) | *(January 1992) | January 1993 |

*Date presented in FY 1988/1989 Descriptive Summary

(U) Explanation of Milestone Changes: One year slip due to denial of FY 1987 Supplemental.

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3326, AC-130U.

A. (U) Project Description: This program funds development and procurement of 12 (10 primary aircraft authorized, 2 back-up aircraft inventory) C-130s and converts these aircraft to the side-firing gunship configuration. The new AC-130U aircraft will have an enhanced capability, improved reliability and maintainability, more survivability than the existing AC-130H aircraft and be more deployable than the older AC-130A gunships. The new aircraft subsystems will include precision navigation, target acquisition radar, fire control computers integrated on the 1553B data bus, elec-

tronic countermeasures, infrared countermeasures, aerial refueling, covert lighting, trainable weapons, and secure communications systems. These subsytems will provide the Gunship the capability to strike targets with surgical accuracy, to loiter safely in the target area for extended time periods, and to perform these tasks in night adverse weather conditions. Where practical, every effort will be made to adapt off-the-shelf equipment, and to the maximum extent, these subsystems will be common with systems on other Air Force SOF aircraft.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 funds were for the beginning of development of the prototype AC-130U. The intent of the program is to develop the unique gunship systems, integrate these systems, and develop the required peculiar support equipment. The effort necessary to integrate the weapons, the sensors, and the avionics system is substantial and comprises the majority of the prototype effort. The systems integration is essential for the gunship to fulfill its operational mission of rapid and accurate target acquisition, identification and selective target destruction. The AC-130U avionics contract award was made to Rockwell International in July 1987.

(2) (U) FY 1988 Program: Development of the prototype AC-130U gunship continues and development of PSE and related technical data has begun. Design efforts, laboratory and integration facility testing and concept proofing continue and fabrication of the prototype aircraft begins. The FY 1988 effort continues software development and integration design for the avionics, target acquisition, and ordnance ballistics computers to allow production and test of the prototype gunship.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 89 effort will focus on three major development areas. First, following critical design review, the integration of the low-light-level TV and the target acquisition radar will be completed. Second, development and refinement of the ballistics and navigation software will continue. Third, peculiar support equipment (PSE) development will begin, with emphasis on defining and developing the required PSE for intermediate and depot support levels. The bulk of the effort will concentrate on low-light-level TV, radar, and fire control support (includes peculiar weapons requirements) items.

(4) (U) Program to Completion: FY 1990 through 1993 RDT&E funds will provide for start and completion of the development of the prototype aircraft with flight test and evaluation beginning in early FY 1990. Upon completion of testing and development of peculiar support equipment in FY 1993, the AC-130U RDT&E will be complete.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Source Selection Complete, Contract Award | *(May 1987) | July 1987 |
| (2) (U) Support Equipment Recommendation Data Items Submitted | | June 1989 |
| (3) (U) Start Prototype Flight Testing | *(October 1989) | December 1989 |
| (4) (U) Completion of DT&E Flight Testing | | August 1990 |

| | |
|---|---|
| (5) (U) Completion of OT&E Testing | June 1991 |
| (6) (U) First USAF Delivery | August 1991 |
| (7) (U) Full Operational Capability (12 aircraft) | *(September 1992) June 1993 |

*Date presented in FY 1988/1989 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) (U) Contract award slipped 60 days due to slip in RFP release.
(3) (U) Flight testing slipped 60 days due to slip in contract award.
(7) (U) Full Operational Capability delayed 10 months due to slip of procurement from FY 1988 to FY 1989.

11. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project 3642, AC/MC-130 Aircrew Training System.

A. (U) Project Description: This project will develop an integrated, state-of-the-art SOF fixed-wing ground based aircrew training system (ATS) to support MC-130 and AC-130 initial qualification, continuation training, update training and combat mission rehearsal requirements. The ATS requirement is driven by existing training restrictions caused by airspace limitations, weather restrictions, and mission safety considerations that dictate rehearsing certain critical tasks in a ground based device. The proposed solution is to acquire a SOF fixed-wing training system composed of curriculum, courseware, scheduling, maintenance, and instruction for all crewmembers of each aircraft. The system will provide a mix of academics, simulator training, and aircraft flight training to produce a combat qualified crewmember.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not applicable.

(2) (U) FY 1988 Program: This program was a FY 1988 new start. The project provides funding for the start of initial prototype development of a training system for both the MC-130 and the AC-130.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continues major portion of the prototype development of the SOF ATS for the MC-130 and AC-130 aircraft.

(4) (U) Program to Completion: FY 1990-1992 funds will provide for completion of the prototype development and testing.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Release Request for Proposal | March 1988 |
| (2) (U) Contract Award | September 1988 |
| (3) (U) MC-130 Course Readiness Review | June 1992 |
| (4) (U) System Validation Complete | March 1993 |

12. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3752, CV-22A

A. (U) Project Description: This effort will result in a CV-22A configured to satisfy SOF mission requirements. Starting with the baseline Marine aircraft, we will provide the contractor with additional communication, navigation, and electronic warfare equipment for integration and testing. External fuel tanks will be developed and tested to extend operational range. In addition, logistics support and training aspects of these Air Force unique systems will be developed to give us aircraft optimally suited for the SOF mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Program Accomplishments: A FY 1987 Congressional reduction and denial of the FY 1987 Supplemental Request caused delay of certain previously planned activities. Reduced quantities of government furnished equipment were purchased for integration in the systems integration laboratory. Several external fuel tank configurations were designed, but wind tunnel testing of those tanks were delayed until FY 1988. An engine structural integrity program was initiated to determine the durability of the Allison engine as it enters the Air Force inventory. A Force operational testing was initiated in the areas of training and logistics support analysis. Extensive Air Force involvement in the airframe, fuel tank, and engine development/integration were needed to ensure our mission requirements were satisfied.

(2) (U) FY 1988 Program: Testing of six prototype air vehicles by a combined contractor/government team will be started. Emphasis will be placed on verifying actual system performance through joint and integrated test and evaluation. Air Force peculiar efforts include avionics integration of SOF unique systems such as a medium accuracy inertial navigation system and the multi-function radar developed under Project 3753, Integrated Digital Avionics. Procurement and integration of electronic warfare systems will begin to provide the CV-22A with an interactive suite able to be operated by the two primary aircrew members. External fuel tank wind tunnel testing will determine which tank is most operationally and fiscally effective; this tank will be fully developed and prepared for flight test. The engine structural integrity program will continue. Other non-avionics systems will also be procured and integrated for flight test in FY 1990. Cost estimates for these efforts are Category II, mature.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Flight testing of the prototype V-22s will continue with Air Force involvement. Procurement and integration of SOF unique equipment such as navigation, communication, and electronic warfare equipment will be completed so that initial testing in the systems integration laboratory can start. External fuel tanks and other non-avionics type systems will be developed/procured and integrated so that development flight testing can begin in FY 1990 and initial operational flight testing can begin in FY 1991.

(4) (U) Program to Completion: Development Test and Evaluation/Operational Test and Evaluation will continue to be a combined contractor/government effort. V-22 Production Release begins in FY 1990 for the Marine Corps. Production Release for the Navy and Air Force is in FY 1992 leading to Air Force SOF Initial Operational Capability in FY 1994. Delivery of a minimum of 55 aircraft for the Air Force will be completed in FY 1998.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Preliminary Design Contract Award | April 1983 |
| (2) (U) Full Scale Development (FSD) Contract Award | May 1986 |
| (3) (U) Long Lead Release (USMC) | 3rd Quarter FY 1987 |
| (4) (U) Operational Test and Evaluation | 2nd Quarter FY 1991 |
| (5) (U) Full Production Release | 1st Quarter FY 1992 |
| (6) (U) First USAF Delivery | 1st Quarter FY 1994 |
| (7) (U) USAF Initial Operational Capability | 4th Quarter FY 1994 |

13. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: <u>1, Combat Aircraft</u>
Program Element: <u>1110011F, Proj #3326, MC-130H</u>

AS OF: JANUARY 1988

<u>Test and Evaluation Data</u>

1. (U) <u>Development Test and Evaluation (DT&E)</u>: The MC-130H Combat Talon acquisition is a follow-on to the MC-130E. No DT&E is accomplished under this Program Element.

2. (U) <u>Operational Test and Evaluation (OT&E)</u>:

(U) Previous Related Testing. Under the Credible Sport II program, an operational utility evaluation (OUE) was conducted (June through September 1982) by the 8th Special Operations Squadron, 1st Special Operations Wing, Hurlburt Field, Florida. The Credible Sport test aircraft was a residual asset of an earlier program unrelated to the Combat Talon II (CT-II) acquisition that incorporated many subsystems technologies and concepts now planned for CT-II. These included integrated, self-contained navigation/precision approach avionics, aerodynamic short takeoff and landing (STOL) features, and advanced cockpit displays. IBM was the integrating contractor. Major deficiencies were found during this test. They included inadequate inertial navigation system accuracy, insufficient display and simultaneous operations capability of the central avionics computer, immature software which adversely affected aircrew workload and provided insufficent failure warnings, and very low reliability.

(U) Qualification Operational Test and Evaluation (QOT&E). A combined OT&E/QOT&E will be conducted on the first four CT-II aircraft. The first three production aircraft will be used for flight testing and the fourth aircraft for technical order verification. Headquarters Military Airlift Command will conduct the dedicated QOT&E beginning in late FY 1988. The major purpose of this QOT&E is to assess the operational effectiveness and operational suitability of the CT-II to determine if it satisfies the documented operational need, to identify system deficiencies, and to identify need for any modifications. The QOT&E will ensure that the deficiencies found during the Credible Sport OUE are correct in CT-II.

(U) Follow-on Operational Test and Evaluation (FOT&E). After completion of QOT&E, the first CT-II aircraft will be used for FOT&E to evaluate solutions to deficiencies found during QOT&E and to develop/refine mission techniques, tactics, and doctrine.

(U) Test report published: <u>Credible Sport II (Phase II) Operational Utility Evaluation Test Report</u>, November 1982.

3. (U) System Characteristics: The following is a list of key performance requirements and objectives for the MC-130H CT-II aircraft:

(U) CT-II Mature Reliability, Maintainability and Availability (RM&A) Weapon System Objectives:

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| - Weapon System Reliability | (U) 90% | TBD |
| - Full Mission Capable Rate | (U) 85% | |
| - Partial Mission Capable Rate | (U) 90% | |
| - Maintenance Manhours per Flying Hours | (U) 20 Hours | |

(U) CT II Avionic Subsystem Objectives

| Characteristic | OT&E/QOT&E | Mature | Demonstrated |
|---|---|---|---|
| - Mean Time Between Maintenance (MTBM)-Inherent (Hours) | (U) 2.0 | (U) 3.0 | TBD |
| - MTBM-Corrective (Hours) | (U) 1.5 | (U) 2.2 | |
| - Mean Time Between Removal (MTBR) (Hours) | (U) 2.4 | (U) 3.5 | |
| - Mean Manhours to Repair (MMR) (HRS) (On Equipment) | (U) 4.7 | (U) 3.2 | |

CT-II Navigation Accuracy:

| Characteristics | Objective/Threshold | Demonstrated |
|---|---|---|
| - (U) Inertial Navigation System (INS) Position Error | .25nm/hr for 10 hours | TBD |
| - (U) Terminal Guidance Accuracies | | |
| -- (U) Forward Looking Infrared (FLIR)/Barometric (BARO) | | |
| -- (U) Radar Mode | | |
| -- (U) Dead Reckoning (DR) Mode | | |
| - (U) Computed Air Release Point (CARP) Accuracies | | |
| -- (U) FLIR/BARO | | |
| -- (U) Accuracies for other CARP modes TBD | | |

Budget Activity: 1, Combat Aircraft
Program Element: 1110011F, Proj #3326, MC-130H

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Activity | Actual Date | Remarks |
|---|---|---|---|
| Training of Test Cadre | August 1986-January 1987 | June 1987 | Training completed at contractor facility |
| OT&E/QOT&E Plan Completed | July 1987 | July 1987 | 90 days prior to start of test |

T&E Activity (Next 12 Months)

| Event | Planned Date | Remarks |
|---|---|---|
| Test Plan Working Group (TPWG) Meetings | One per Quarter | Continue test planning |
| QT&E/QOT&E Start | 3rd Quarter FY 1988 | Four aircraft in test program. |

Budget Activity: 4, Tactical Programs
Program Element: 1110011F, Proj #3326, AC-130U

AS OF: JANUARY 1988

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The AC-130U program procures 12 new fixed-wing gunships. The program converts planned C-130H airframes into a side-firing platform with integrated avionics, defensive systems, and weapons. No DT&E is planned for this program.

2. (U) Operational Test and Evaluation (OT&E):

(U) Previous Related Testing: The Special Mission Test and Evaluation Center of the Military Airlift Command (MAC) has completed or is conducting AC-130 related OT&E projects on AC-130H Enhancements, low-level area saturation strafing, and new 40mm munitions.

(U) Qualification Operational Test and Evaluation (QOT&E): The AC-130U test program consists of combined Qualification Test and Evaluation (QT&E) versus DT&E/Initial Operational Test and Evaluation (IOT&E). As such, the purpose of the test is to verify specification compliance and operational requirements, identify deficiencies, and to suggest future improvements. Production decisions will have been completed prior to the availability of the test information/results; however, the risk caused by the concurrency in this program is greatly reduced by the test information from the AC-130H program. The AC-130U test program will be conducted from January 1990 through July 1991. The Aeronautical Systems Division, Director of Special Operations Forces System Program Office (ASD/AFZ), as agent for Air Force Systems Command (AFSC), the implementing command, will be responsible for the AC-130U test program as prescribed in DOD Directive 5000.1 and 5000.3, AFR 80-14, HQ USAF Program Management Directives and HQ AFSC Program Direction. The Air Force Flight Test Center will conduct the OT&E as the Responsible Test Organization and will be responsible for coordinating and integrating overall OT&E/QOT&E activities in accordance with approved test plans, the Test and Evaluation Master Plan, and guidance from the Program Office, Test Plan Working group, and Safety Review Board. The combined test force will plan and conduct ground and flight test operations. A series of tests span the developmental and operation life of the AC-130U system. The test program will combine all aircraft test objectives into a logical, time-phased program prioritized to provide adequate data to support program objectives. Combined OT&E and QOT&E will be performed to the maximum extent possible. One AC-130U aircraft will be used during the combined flight test program at Edwards AFB, CA. The test aircraft will be the first production AC-130U. Any deficiencies or improvements identified by test will be retrofitted into the production aircraft. The avionics integration contract was awarded to Rockwell International on 2 July 1987.

(U) Follow-On Operational Test and Evaluation (FOT&E): After completion of QOT&E, HQ Military Airlift Command plans to conduct a two-phase FOT&E. Phase I will use the QOT&E aircraft to refine estimates made during QOT&E, test and evaluate proposed fixes for previously identified discrepancies, and develop and/or refine tactics and techniques for operational use. Phase II will be an FOT&E using a production aircraft. During this phase, we will complete all test and evaluation initiated by Phase I plus accurately measure the systems reliability, maintainability, and survivability characteristics.

Budget Activity: 4, Tactical Programs
Program Element: 111001lF, Proj #3326, AC-130U

3. (U) **Systems Characteristics:** The following is a list of key performance requirements and objectives for the AC-130U Gunship aircraft.

| Characteristic | Objective/Threshold | Demonstrated |
|---|---|---|
| (U) Air Vehicle Performance | The AC-130U shall have performance characteristics as good as or better than performance levels of the current AC-130H. | To be determined (TBD) |
| (U) Avionics Performance | Full operation in any mode after a warm-up time of 10 minutes. | TBD |
| Offensive Performance | system firing accuracy in direct mode with visual sensors and not greater than in offset and adverse weather mode. | TBD |
| Defensive performance | The AC-130U shall have a defensive suite able to detect and counter appropriate | TBD |
| Target acquisition | The AC-130U visual sensors will resolve targets and will possess 360° search with two fields of view | TBD |
| (U) Navigation accuracy | Navigation system accuracy shall be .8 NM/hr for the first hour and 1.0 NM/hr for the 2nd through the 10th hour. | TBD |

udget Activity: 4, Tactical Programs
rogram Element: 1110011F, Proj #3326, AC-130U

| Characteristics | Objective/Threshold | Demonstrated |
|---|---|---|
| (U) Reliability | | |
| Mission reliability (MR) | 97% | To Be Determined (TBD) |
| Mean Flight Hours Between Failure | 2.3 hrs | TBD |
| Mean Flight Hours Between Unscheduled Maintenance | 1.1 hrs | TBD |
| Mean Flight Hours Between Unscheduled Repair | 2.9 hrs | TBD |
| (U) Maintainability | | |
| Maintenance Man Hours/Flying Hour (Organizational and Intermediate Level - excluding support) | 8.4 hrs | TBD |
| Mean Time to Repair (On equipment) | 2.6 hrs | TBD |

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| Test Plan Working Group (TPWC) | 1 Qtr FY 1988 | 27-28 Oct 87 | Assist program office in preparing Test and Evaluation Master Plan |
| Test Plan Outline | 2 Qtr FY 1987 | 9 Feb 87 | |

T&E Activity (Next 12 Months)

| Event | Planned Date | Actual Date | Remarks |
|---|---|---|---|
| TPWC | March 1988 | | Participate in TPWG meeting. |

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303110F
DOD Mission Area: 333 - Strategic Communications

Title: Defense Satellite Communications System (DSCS)
Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 16,833 | 43;325 | 38,061 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Defense Satellite Communications System (DSCS) provides super high frequency satellite communications for secure voice and high data rate transmissions. It satisfies the unique and vital national security communications requirements of worldwide military command and control, crisis management, relay of intelligence and early warning data, treaty monitoring and surveillance information, and diplomatic traffic. Specifically, the DSCS supports the National Command Authorities, the Worldwide Military Command and Control System, the Defense Communications System, the Diplomatic Telecommunications Service, the White House Communications Agency and mobile forces of all Services. There is a continuing requirement for this communication service.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 16,833 | 21,398 | 53,596 | Continuing | N/A |
| Missile Procurement | 110,453 | 75,870 | 21,105 | Continuing | N/A |

EXPLANATION: (U) FY 88 RDT&E increased to initiate Full Scale Develoment (FSD) of the Integrated Apogee Boost Stage (IABS). FY 89 RDT&E decreased due to deferral of DSCS IIIC FSD. FY 89 Procurment increased to procure three IABS for launch of DSCS III Satellites using the MLV-II booster. FY 89 RDT&E funds first time integration of DSCS III satellites on TITAN IV as a backup system to assure continued access to space.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Funds | 109,538 | 71,900 | 54,412 | Continuing | N/A |
| Quantities | 1 | 1 | 0 | Continuing | N/A |

5. (U) **RELATED ACTIVITIES:** The Defense Communications Agency is responsible for overall Defense Satellite Communications System program management, system engineering, and satellite operational direction. The Army develops and procures ground terminals under PE 0303142A, Defense Satellite Communications System. The Navy procures shipborne terminals under PE 0303109N, Satellite Communications System. The Air Force is developing Medium Launch Vehicles (MLV-II) under PE 0305119F, Space Boosters. The Air Force also has funding for ground equipment, construction, operation and maintenance, and manpower to support its portion of the ground segment in PE 0303605F, Satellite Ground Terminals.

6. (U) **WORK PERFORMED BY:** The Air Force Space Division, Los Angeles, CA, is responsible for the space segment of the Defense Satellite Communications System. TRW, Redondo Beach, CA, is the prime contractor for the DSCS II satellites. General Electric Company, Valley Forge, PA, is the prime contractor for the DSCS III spacecraft. The Aerospace Corporation, El Segundo, CA, provides general systems engineering and integration to the Air Force Space Division System Program Office.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:** Not applicable

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1989:**

(U) Project: 0303110F, Defense Satellite Communications System

A. (U) Project Description: The Defense Satellite Communications System (DSCS) provides super high frequency satellite communications for secure voice and high data rate transmissions. The program acquires DSCS satellites DSCS satisfies unique and vital national security communications requirements of worldwide military command and control, crisis management, relay of intelligence and early warning data, treaty monitoring, and diplomatic traffic. The DSCS program acquires DSCS satellites in support of the wideband, high data rate communication requirements of DOD and other other national secuiity activities.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Acquisition of the seven multiyear satellites continued with two more satellites, III-B12 and -B13, fully funded. RDT&E continued on the Titan IV first-time integration as well as changes for the DSCS satellites to be procured after the current multiyear procurement. Satellite III-B7 completes system testing. Pending recovery of space launch capability, all delivered DSCS satellites are maintained in storage with periodic inspection and maintenance. Studies determined that the last ten DSCS III satellites could be launched using a Medium Launch Vehicle (MLV-II) with no increased overall cost. This will provide assured access to space for critcal communication assets.

(2) (U) FY 1988 Program: The last multiyear DSCS III satellite, III-B14, will be funded. DSCS III Satellites III B8 and -B9 will be delivered. Remaining delivered DSCS II & III satellites continue in storage. The Titan IV integration will continue. Satellite hardware (Integrated Apogee Boost Stage - IABS) associated with the MLV-II will be developed along with first time integration activities. Studies and system requirements reviews for satellites satellites acquired after the last multiyear procurment will be conducted.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of the Integrated Apogee Boost Stage and first-time integration with the MLV-II will continue. First-time integration of the DSCS satellite with the Titan IV backup booster will be completed. Studies will continue to determine DSCS III follow on requirements and capabilities. The FY 1989 program includes funds for procurement of the Integrated Apogee Boost Stages will be available for The cost estimate is Category III, Budgetary.

(4) Program to Completion: Low level development will be performed on the replenishment satellites to accommodate changes for parts obsolescence and to develop impovements to life cycle costs, reliability, maintainability and producibility. Efforts will be made to find an affordable solution to the increased communications requirements projected for post 1995.

C. Major Milestones:

| | | Milestones | Dates |
|---|---|---|---|
| | | Defense Satellite Communications System II | |
| (1) | (U) | Initial Contract Award | March 1969 |
| (2) | (U) | Initial Satellite Launch | November 1971 |
| (3) | (U) | Launch of DSCS II-F16 (with DSCS III-A1) | October 1982 |
| (4) | | Remaining satellite Launch (with DSCS III-A2) | |

(U) * Date presented in FY 1988/89 Descriptive Summary

C. **Major Milstones:** Continued

**Milestones**

**Defense Satellite Communications System III**

| | | | |
|---|---|---|---|
| (1) | (U) | Defense Systems Acquisition Review Council I | December 1974 |
| (2) | (U) | Award Phase I (Preliminary Design) Contracts | December 1975 |
| (3) | (U) | Defense Systems Acquisition Review Council II | December 1976 |
| (4) | (U) | Award Phase 2 (Engineering Development) Contract | February 1977 |
| (5) | (U) | Defense Systems Acquisition Review Council III Production Decision | December 1981 |
| (6) | (U) | Launch First Demonstration Flight Satellite | October 1982 |
| (7) | | First Production Satellite Launches on Shuttle | |
| (8) | | Refurbished qualification satellite launch availability | |
| (9) | | Full complement of orbiting DSCS III's (seven) | |
| (10) | (U) | Delivery of last DSCS III multiyear procured satellite | March 1991 |
| (11) | | Launch availability of DSCS IIIB replenishment | |

(U) * Date presented in FY 1988/89 Descriptive Summary.

(S) **Explanation of Milestone Changes:**

(4) (U) Problems with the Titan 34D program resulted in delay of launch of the last DSCS-II satellite and the DSCS III-A2 satellite.

(9) (U) Estimate based on anticipated launch using Integrated Apogee Boost Stage (IABS) under development.

(11) (U) Current estimate.

9. (U) **COOPERATIVE AGREEMENTS:** Not applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303126F  Title: Long Haul Communications - DCS
DOD Mission Area: 393 - Long Haul Communications  Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 7,053 | 5,132 | 4,751 | Continuing | N/A |
| 2022 | Automated Digital Communications Processing Techniques | 3,690 | 2,115 | 1,652 | Continuing | N/A |
| 2155 | Systems Control | 2,072 | 1,809 | 1,755 | Continuing | N/A |
| 2157 | Transmission Improvements | 911 | 1,028 | 1,057 | Continuing | N/A |
| 2206 | Digital European Backbone (DEB) | 190 | 180 | 180 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is the Air Force portion of the Tri-service RDT&E program for communications networks, including the Defense Communications System (DCS). The DCS provides the long distance, common user, switched telecommunications network to satisfy requirements of the National Command Authority, the Department of Defense, and certain other government agencies. This RDT&E program defines system architectures, specifies design parameters, and develops communications technology for modernization and improvements of communications networks, including the DCS. Work in this program element provides for an orderly transition to a second generation DCS and determines the architecture for the third generation DCS. The second generation DCS is characterized by digital transmission and switching subsystems. The focus for the third generation DCS will be on unified direction and control and subsystem interaction between differing switched networks (e.g., voice and data). This program element includes technology development in automated digital communications processing and distribution techniques, performance assessment and network management, and transmission improvements.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 5,442 | 5,154 | 4,756 | Continuing | N/A |
| Other Procurement | 21,721 | 22,837 | 24,102 | Continuing | N/A |

EXPLANATION: (U)

FY 1987: RDT&E increased $1,611 thousand due to funds added for DDN and operators handbook.
FY 1989: Other Procurement funds reduced $16,602 thousand due to FY 1989 budget reductions.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| TOTAL | 23,671 | 24,837 | 7,500 | Continuing | N/A |
| Project 2206 (Digital European Backbone) | | | | | |
| Funds | 17,950 | 22,988 | 7,500 | Continuing | N/A |
| Quantities | | Not Applicable | | | |
| Project 2440 (Secure Telephone Systems) | | | | | |
| Funds | 5,021 | 1,349 | 0 | 0 | 9,524 |
| Quantities | | Not Applicable | | | |
| Military Construction: | | | | | |
| Project 2206 (Digital European Backbone) | | | | | |
| Funds | 7,750 | 3,800 | 1,220 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: The Digital European Backbone (DEB) project (2206) involves Tri-Service funding and includes installation of equipment at Army, Navy, and Air Force sites. Overall program management for this project is exercised by the Defense Communications Agency (DCA). DCA's Management Engineering Plan (MEP) tasks the Army to procure the digital radios and multiplexer equipment. The MEP tasks the Air Force to develop and procure the digital troposcatter modem. RDT&E for the Secure Conferencing Project, part of Secure Telephone Systems, is funded under Program Element 0603735F, Worldwide Military Command and Control System Architecture.

6. (U) WORK PERFORMED BY: Air Force Systems Command manages this program element through the Electronic Systems Division (ESD), Hanscom Air Force Base, MA (Project 2206) and the Rome Air Development Center (RADC), Griffiss AFB, NY (Projects 2022, 2155 and 2157). ESD receives technical support from the MITRE Corporation, Bedford, MA, and Computer Engineering Associates, Avon, MA. Major contractors for Project 2206 are TRW, San Luis Obispo, CA, and GTE, Needham, MA. Major contractors for projects 2022, 2155, and 2157 are: Computer Sciences Corporation, Falls Church, VA; Honeywell, Tampa, FL; RCA, Camden, NJ; and Signatron Inc, Lexington, MA. All of these support the tasks managed by RADC. Other contractors are: Digital Communications Corporation, Germantown, MD (Project 2157); Western Union, McLean, VA (Project 2022); Ford Aerospace and Communications Corporation, Colorado Springs, CO (Project 2022); Harris Corporation Melbourne, FL (Project 2157); Hazeltine, Greenlawn, NY (Project 2157); and Raytheon, Sudbury, MA (Project 2157).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2022, Automated Digital Communications Processing. As the Defense Communications System (DCS) transitions from an analog to an all digital system, new capabilities will emerge. Systems to exploit these capabilities will be designed and tested under this project. First is a Multinet Gateway device which will enable multilevel secure interfaces between the DCS and other digital networks (e.g., commercial systems). The ability to connect the DCS to other digital networks in a secure way will significantly improve survivability by providing more alternate routing possibilities should segments of the DCS fail in crisis situations. Second is an initial series of tests to define and evaluate performance parameters for the Defense Switched Network, the follow-on to the current Automatic Voice Network (AUTOVON). Security certification work on the advanced development multinet gateway devices began in FY 1987. Certification work will be completed in late FY 1988. In FYs 1987 and 1988, in-house and contractual efforts to evaluate voice/data integration technologies, including integration methods using circuit-switched, hybrid-switched, and packet-switched approaches, will continue. Beginning in FY 1988, RADC will initiate studies and investigations to define advanced network concepts involving such disciplines and technical areas as advanced switching technologies, network operating systems, and routing and information flow control. Beginning in FY 1988 and continuing into FY 1989, RADC will develop and demonstrate technologies for multi-media (e.g., voice, facsimile, data, and video) user applications. Areas of emphasis will include highly intelligible, low data rate voice encoding schemes, multimedia work stations, and multilevel secure terminals.

B. (U) Project: 2155, Systems Control. This project will improve DCS network management and control by developing techniques, hardware, and software to provide improved performance assessment, failure detection, failure isolation and reporting, and restoral and reconstitution on a worldwide basis. A second major effort is the design effort for the Base Information System Management Center which was completed in FY 1987. Results were given to the Air Force Communications Command for incorporation into the Base Information Digital Distribution System. In FY 1987, RADC began to develop operational concepts, deployment strategies, and software programs to permit multiple Digital Patch and Access units within a subregion to be netted together for real-time coordinated operation. A continuing effort through FY 1989 will evaluate the feasibility of using selected commercial equipment in DoD communications networks.

C. (U) Project: 2157, Transmission Improvements. This project will improve transmission, survivability, efficiency, capacity, and reliability of Air Force and DCS communications links by applying new techniques such as millimeter wave and fiber optics, and by developing equipment embodying new Electronic Counter-countermeasures (ECCM) technology. In FY 1987, development work continued to provide narrowband high frequency radios with jam resistance, high data rates, and improved voice recognition features; an advanced development model of multinode, multirate digital microwave radios with ECCM features, including adaptive antenna nulling; and a high power amplifier for troposcatter

radios which will increase efficiency up to 70 percent and reliability by 300 percent. Development of a troposcatter angle diversity retrofit kit for use in Digital European Backbone (DEB) radios continued. This kit will employ advanced diversity combining techniques to more efficiently use the frequency spectrum. This effort will be completed in FY 1988. In FY 1988, Rome Air Development Center (RADC) will initiate development of algorithms and protocols, with required hardware and software for implementation, to provide multi-band transmission capabilities embodying a combination of diverse propagation media and network communications subsystems. Beginning in FY 1989, RADC will apply emerging technologies, such as artificial intelligence, optics, and very high speed integrated circuitry, to develop, test, and demonstrate a sentient radio system.

D. (U) Project: 2206, Digital European Backbone (DEB). DEB is the approved program for digital upgrade of the Defense Communications System (DCS) in Europe. The program stems from the National Command Authority's direction to secure DCS links, the rapid growth of high speed data requirements, and major force deployments in Europe. One phase of DEB was completed in 1979. The remainder of DEB is planned to use the DCS standard digital radio and multiplex equipment known as DRAMA. The first segment of DEB using DRAMA equipment became operational in June 1984. The remainder of the DEB upgrade will extend the improved operation from the Northern Atlantic to Italy and Spain. In FYs 1987, 1988, and 1989, the majority of the installations will be in the United Kingdom. The upgrade is scheduled to be completed in the mid-1990. The Air Force is the lead military department for the overall upgrade.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303128F
DOD Mission Area: 393 - Long Haul Communications and the NCS

Title: Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)
Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 51,883 | 1,289 | 0 | 0 | 77,643 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Department of Defense requires responsive and cost effective message communications services. These services must support the requirements of the National Command Authorities, the Joint Chiefs of Staff, Unified/Specified Commands, the Military Departments, and other DOD and US government agencies. To better meet these user requirements, the I-S/A AMPE program was established by Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) memorandum, 11 October 1978, "Integrated AUTODIN System Architecture Report." The I-S/A AMPE would have provided a combined Defense Special Security Communication System/General Service (DSSCS/GENSER) accredited, standard base-level automated message processing exchange (AMPE) capability; and an interface to the Defense Data Network (DDN). The I-S/A AMPE would have been a standard telecommunications element for critically needed secure message communications services required by the widely dispersed DOD elements in peace and war.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 52,408 | 1,296 | 13,240 | 7,155 | 98,570 |
| Other Procurement | 0 | 0 | 14,757 | 143,451 | 159,392 |

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not applicable.

5. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: As a result of a $33 billion cut in the FY 1989 defense budget, the I-S/A AMPE program funds were eliminated. On December 16, 1987, the Defense Review Board supported the I-S/A AMPE program cancellation and on December 23, 1987, Air Force Communications Command was directed to cancel all I-S/A AMPE related contracts. The program office is deactivating and a final government position addressing contract liability is being developed for negotiation. There are no future plans for continuing the I-S/A AMPE effort.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303144F — Title: Electromagnetic Compatibility Analysis Center (ECAC)
DOD Mission Area: 360 - Support & Base Communications — Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 7,485 | 8,083 | 8,427 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The ECAC is a Department of Defense (DOD) Center administered by the Air Force. The success of strategic and tactical forces requires that communications-electronic (C-E) equipment supporting command, control, communications, and intelligence ($C^3I$) function as intended in its operating environments. The following tasks support this objective:

A. (U) DOD Frequency Management and Engineering Support System: This system provides direct operational support to strategic and, eventually, tactical units of the DOD through a reliable, distributed, computer-aided, worldwide frequency management information and engineering support system. ECAC is responsible for the development and maintenance of the joint component of this system, known as the Frequency Resource Record System.

B. (U) Joint Operations Planning: Provides direct assistance to the Joint Chiefs of Staff (JCS) and the Unified and Specified Commands in determining the frequency resource requirements, joint operations frequency management capabilities, and de-confliction procedures necessary to ensure that C-E equipment supporting $C^3I$, electronic warfare and intelligence functions will operate as required without suffering electromagnetic interference.

C. (U) DOD EMC Technology Transfer Program: Provides operating units with EMC engineering capabilities through the development and maintenance of software for generally available computers.

D. (U) Projects: Provides direct support to system acquisition program management offices in designing and evaluating C-E equipment's ability to function in its planned operating environments.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 7,485 | 8,132 | 8,618 | Continuing | N/A |

EXPLANATION: (U) The reductions reflect revised fiscal guidance and redirection of funds to higher priority programs. The $0.2M reduction in FY 1989 will preclude installation of the Enhanced Frequency Resource Record System (FRRS) at four European Command locations: Headquarters, European Command; Headquarters, United States Air Forces in Europe; Headquarters, 5th Signal Command; and Headquarters, US Navy, Europe. Moreover, follow-on enhancements of the FRRS installed at Pacific Command and Atlantic Command locations will be deferred.

Program Element: 0303144F
DOD Mission Area: 360 - Support & Base Communications

Title: Electromagnetic Compatibility Analysis Center (ECAC)
Budget Activity: 5 - Intelligence and Communications

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Operation and Maintenance: Funds | 4,656 | 4,895 | 5,102 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: None.

6. (U) WORK PERFORMED BY: The IIT Research Institute at Annapolis, Maryland, under contract through the Electronic Systems Division, Air Force Systems Command.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: PE0303144F, Electromagnetic Compatibility Analysis Center.

A. (U) Project Description: Policy and guidance for the operation of ECAC is provided by the Chairman, Joint Chiefs of Staff, and the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence ($C^3I$). The Air Force is responsible for planning, budgeting, and administration. RDT&E and Operation and Maintenance funds provided under PE 0303144F cover the development and maintenance of the worldwide DOD Frequency Management Information and Engineering System, the analysis of the capability of communication-electronics equipment to perform $C^3I$ and other electronic functions in support of frequency allocation for the Military Communications Electronics Board, the transfer of electromagnetic compatibility technology to elements in the field, and the development of data bases and analytical capabilities. Acquisition programs also provide $30 million per year to support analyses of their specific systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments:

(a) (U) DOD Frequency Management and Engineering Support System: ECAC completed Phase II of the Frequency Management and Engineering Improvement Plan, upgrading the frequency management equipment/software of the Services and the Defense Communications Agency in the Washington, D.C. area to enable autonomous operation in the event of a disconnect from the Center. ECAC handled over 150,000 frequency transactions during the year. The second tier of the Space Systems Data Base for non-geostationary space systems was completed. The Center's Equipment Characteristics File was converted to the Sperry Data Base Management System 1100, providing the flexibility to handle data concerning complex, multi-functional, communications-electronics (C-E) systems.

(b) (U) Joint Operations Planning: ECAC evaluated ten major Joint Chiefs of Staff (JCS) contingency plans and made recommendations concerning frequency resource requirements, joint operations frequency management capabilities, and de-confliction procedures to the JCS. Replacement of the Center's main frame computer with a Sperry 1100/92SV were completed. The Center joined the DOD Information System Network by completing the hookup of the PDP 11/84 computer in the Sensitive Compartmented Information Facility. The Tactical Environment Generation System was converted to utilize video disk technology for the storage and retrieval of map feature information. The Tactical Environment Analysis System was tested and validated. The procedures for determining the compliance of proposed C-E systems acquisitions with military standards and specifications was automated to improve productivity. The capability of about 220 proposed systems to operate in their intended environments was examined for the Military Communications Electronics Board.

(c) (U) DOD EMC Technology Transfer Program: ECAC provided the US Army Battlefield Electromagnetic Environment Office the software to support the Tactical Environment Generation hardware. Capabilities that the Center has developed in support of the US Army Tactical Frequency Engineering System were converted to run on the Micro-VAX series of computers. The basic package of electromagnetic compatibility engineering capabilities provided to the US Air Force Frequency Management Office in 1986 was converted to run on the Micro-VAX systems that are being installed at European Command, Atlantic Command, and Pacific Command Headquarters in conjunction with the DOD Frequency Management and Engineering System software.

(d) (U) Projects: Reimbursed sponsor projects made up about 70% of the ECAC support effort. Examples of the nearly 200 projects supported by ECAC in FY 1987 are the US Marine Corps' AV-8B and V-22 developments, HAVE QUICK Radio development, and the deployment of Global Positioning System (GPS) terminals on various platforms. Air Force projects supported include the Combat Identification System, Joint Tactical Information Distribution System, F-16, Worldwide Airborne Command Post, North Warning System, Ground-Wave Emergency Network, Single-Channel Ground and Airborne Radio System (SINCGARS), GPS, Milstar, Spacecraft Environment, and Spectrum Management Information System. Army projects/organizations supported include the Mobile Subscriber Equipment Program, Ground Mobile Forces Satellite Program, SINCGARS, US Army Information Systems Command Operational Evaluation Centers (National Training Facility, Combat Maneuver Training Complex, and Light Forces National Training Center), and the Army Defense Electronic Warfare System. Navy projects supported include AEGIS, PHALANX, Shipboard Topside Design, satellite crosslink compatibility for the Strategic Defense Initiative (SDI), and frequency assignment and frequency allocation automation. In addition, ECAC supported the Frequency Assignment System 3 for the North Atlantic Treaty Organization and the Defense Satellite Communication System uplinks and downlinks for the Defense Communications Agency.

(2) (U) FY 1988 Program:

(a) (U) DOD Frequency Management and Engineering Support System: ECAC will begin Phase III of the Frequency Management and Engineering System Improvement Plan by installing Atlantic Command and Pacific Command elements of the system. This improvement will give these two unified commands a computer-aided frequency management and engineering capability that can operate autonomously. The Center will process about 170,000 frequency assignment transactions in FY 1988.

(b) (U) Joint Operations Planning: Twenty major Joint Chiefs of Staff (JCS) contingency plans will be evaluated and recommendations concerning frequency resource requirements, joint operations frequency management capabilities and de-confliction procedures will be provided to the JCS. The Tactical Environment Analysis System will become operational. The capability to address electromagnetic compatibility (EMC) problems with respect to millimeter wave and electro-optic systems will become fully operational. A capability will be developed and implemented to provide Military Communications Electronics Board (MCEB) members and Service Frequency Management Offices with remote access to the status of Frequency Allocations and Frequency Allocation Requests concerning communications-electronics systems in the experimental, developmental and operational phases of their life cycles. The analysis of the capability of about 200 proposed communications-electronics equipment to operate in their intended environment will be completed for the MCEB.

(c) (U) DOD EMC Technology Transfer Program: EMC engineering analysis capabilities ECAC has made available to the field on the Hewlett-Packard 41C series of desktop calculators will be reprogrammed to operate on Zenith, IBM, and Wang personal computers in the field. An initial operating capability to assist European Command, Atlantic Command, and Pacific Command elements in the more efficient management of available frequency resources to support ultra-high-frequency air-ground-air communication requirements will be installed on selected Micro-VAX II and III computers in the DOD Frequency Management and Engineering System. ECAC will also give field units having access to the DOD Frequency Management and Engineering System an initial operating capability to employ high-frequency (HF) pooling techniques to improve the frequency supportability of HF communication requirements.

(d) (U) Projects: ECAC will continue EMC support to the Army on Mobile Subscriber Equipment, US Army Information Systems Command Training Centers, Single-Channel Ground and Airborne Radio System, and the Army Air Defense Artillery Threat Simulator. Support to Army SDI efforts will begin. Air Force support will continue on Combat Identification System, Joint Tactical Information Distribution System, F-16, Worldwide Airborne Command Post, North Warning System, Global Positioning System (GPS), Milstar, Spacecraft Environment, and Spectrum Management Information System. Marine Corps EMC efforts will be supported in the V-22 development, improved HAVE QUICK employment, and further GPS employment. Support to the Navy on AEGIS, PHALANX, SDI satellite crosslink, Shipboard Topside Design, and frequency allocation/assignment will continue. Support to the North Atlantic Treaty Organization for the Frequency Assignment System 3 and to the Defense Communications Agency for the Defense Satellite Communication System uplinks and downlinks will also continue.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request:

(a) (U) DOD Frequency Management and Engineering Support System: Completion of Phase III, installation of European Command elements of the system (4 locations), will be deferred. Phase IV, System Enhancement Phase, based upon requirements validated by the Joint Chiefs of Staff (JCS), will also be deferred.

(b) (U) Joint Operations Planning: All revised JCS contingency plans available to the Center will be reevaluated. Five representative European Command contingency plans will be evaluated for the first time.

(c) (U) DOD EMC Technology Transfer Program: Terrain-dependent radar and communication system coverage analysis capabilities will be transferred to JCS-designated operational organizations.

(d) (U) Projects: The reimbursed sponsor program will continue to support the Strategic Defense Initiative, Joint Tactical Information Distribution System, Combat Identification System, Ground Wave Emergency Network, Single-Channel Ground and Airborne Radio System, Milstar, etc. New projects requested by the Services will be initiated.

(4) (U) Program to Completion: The requirement for ECAC to support EMC design, analysis, and planning for the Department of Defense is a continuing one. To meet this requirement, ECAC must continue to update and maintain its existing data bases and analytical techniques, while developing new ones to accommodate advancing technology. In addition, ECAC must respond to an estimated 200 requests for analytical support each year, as well as approximately 7000 requests for data base outputs.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

# AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0303401F — Title: Communications Security
DOD Mission Area: 380 - Communications Security (COMSEC) — Budget Activity: 5 - Intelligence and Communications

1. **RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)**

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | | | | Continuing | N/A |

2. (U) **BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** The Air Force Research and Development (R&D) portion of the overall Department of Defense (DOD) COMSEC program addresses problems encountered in adapting general purpose cryptographic equipment for use in new Air Force communications systems. The efforts are primarily directed at insuring that all systems being developed by the Air Force meet current national communication security requirements. The program develops ancillary systems such as voice digitizers, COMSEC equipment adapter units, and, with National Security Agency (NSA) development authority, integrated COMSEC systems to meet specific Air Force Command, Control, Communication, and Intelligence ($C^3I$) requirements.

3. **COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)**

| | | | | | | |
|---|---|---|---|---|---|---|
| RDT&E | | | | | Continuing | N/A |

4. (U) **OTHER APPROPRIATION FUNDS:** Not Applicable.

5. (U) **RELATED ACTIVITIES:** The NSA is the overall manager of communications security equipment research and development under the policy guidance of the Assistant Secretary of Defense $C^3I$. The Services perform efforts under common Program Element 0303401. The Air Force Electronic Security Command (ESC) performs COMSEC testing on equipment proposed for operational use in the USAF and also recommends the application of cryptographic equipment to operational commands.

6. (U) **WORK PERFORMED BY:** All research and development tasks under this program are managed through the Rome Air Development Center (RADC) of the Air Force Systems Command (AFSC), Electronic System Division (ESD), Hanscom AFB, MA. Contractors are: Lincoln Laboratory, Bedford, MA. (digital speech research); Arcon Corp., Bedford, MA. (math analysis and software development for in-house activities); and Massachusetts Institute of Technology, Boston, MA. Additional research and development (R&D) is accomplished in-house and through co-sponsorship of programs with National Security Agency, Naval Ocean Systems Center, National Bureau of Standards and the Department of Transportation Research Center.

Program Element: 0303401F    Title: Communications Security
DOD Mission Area: 380 - Communications Security (COMSEC)    Budget Activity: 5 - Intelligence and Communications

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0303401F, Communications Security.

A. (U) Project Description: The project implements specific R&D task requirements and schedules using in-house resources supplemented by development contracts. Products are transitioned to Electronic Security Command (ESC), Air Force Systems Command (AFSC), Electronics Systems Division (ESD), and National Security Agency (NSA). Tasks within this project are: 01, TEMPEST R&D; 02, COMSEC Technology; 03, Secure Voice. The TEMPEST task directs improving quality of TEMPEST testing to handle an increasing workload with new threat phenomena. The COMSEC task consists of research in use of fiber optic communication and developing a modular COMSEC architecture to integrate all electronic/electrical/control functions in an aircraft. Work in the Secure Voice task consists of developing robust, interoperable digital speech systems with increased intelligibility and quality.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: As part of the TEMPEST task, work on signal processing techniques continued, using the broad-band antenna and Fibre Optic Electromagnetic Antenna (FOEMA) developed in 1986. TEMPEST power-line conduction and emanations phenomena were researched. COMSEC architectures were analyzed for application to an integrate avionics system. Development of a capability to conduct speech quality testing for secure voice systems was initiated. Research on speech digitizing algorithm for secure voice systems for the year 2000 and beyond continued. Specifications were be prepared for enhancing the STU-III system with a digital conferencing capability.

(2) (U) FY 1988 Program: Full-scale development will begin on an automated TEMPEST analysis system based on the research done in previous years. This system will permit testing of equipment for which no test capability presently exists, as well as appreciably reducing the time and manpower needed to conduct these tests. Work will begin on techniques for simultaneous control of multiple embedded COMSEC devices in command, control, and communication ($C^3$) networks such as the avionics equipment netted together on an aircraft. Advanced development of the next generation secure voice system will be contracted for based on the research performed in the labs previously. This system will improve the intelligibility of secure voice systems operating at different transmission rates. In-house, a capability to measure the effect of accented and foreign language intelligibility in secure voice systems will be developed. A digital conferencing bridge will be developed by contract for the Secure Telephone Unit (STU-III), giving a conference call capability to this new system.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development and testing of the automated TEMPEST analysis system and the secure conferencing bridge for the STU-III will be completed. Advanced development of the next generation secure voice system will also be finished. Work will begin on a very high speed encryption system for video and graphics data, based on new technologies in data error control and security.

(4) (U) Program to Completion: This is a continuing program consisting of directed tasks in advanced TEMPEST, COMSEC and secure voice research and development to insure Air Force fielded systems are capable of countering exploitation efforts.

C. (U) Major Milestones:

| | | Milestones | Date |
|---|---|---|---|
| (1) | (U) | Secure Voice Digital Translation Demo | 3rd Qtr FY 1987 |
| (2) | (U) | Automated TEMPEST Optical Correlation Demo | 4th Qtr FY 1987 |
| (3) | (U) | Contract for Automated TEMPEST Analysis System | 1st Qtr FY 1988 |
| (4) | (U) | Contract for Advanced Development on Next Generation Secure Voice System | 1st Qtr FY 1988 |
| (5) | (U) | Contract for Secure Digital Conferencing Bridge | 1st Qtr FY 1988 |
| (6) | (U) | Developmental and Operational Tests of the Secure Digital Conferencing Bridge. | 3rd Qtr FY 1989 |
| (7) | (U) | Automated TEMPEST Analysis System Complete | 3rd Qtr FY 1989 |
| (8) | (U) | Complete Development and Test and Evaluation of Next Generation Secure Voice System | 1st Qtr FY 1990 |

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305114F — Title: Traffic Control/Approach/Landing Systems (TRACALS)
DOD Mission Area: 357 - Navigation and Position Fixing — Budget Activity: 5 - Intelligence & Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 21,407 | 25,891 | 25,114 | Continuing | N/A |
| 2026 | System Support | 289 | 343 | 445 | Continuing | N/A |
| 2759 | Mobile Microwave Landing System (MMLS) | 439 | 16,226 | 13,069 | 9,200 | 36,263 |
| 2966 | New Mobile Rapcon | 5,600 | 4,000 | 2,800 | TBD | TBD |
| 2967 | Air Traffic Control Survivability | 5,193 | 4,000 | 0 | 10,407 | 16,000 |
| 3042 | BAMBOO TREE | 400 | 400 | 400 | Continuing | N/A |
| 3587 | MLS Avionics | 9,486 | 922 | 8,400 | 42,029 | 71,287 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the Air Force with the air traffic control and landing equipment required for safe, efficient, worldwide, all weather flying operations. The mission need is to provide take-off, en-route and landing guidance and surveillance in order to meet wartime sortie requirements. In peacetime, the need is to support training, logistics and other operational flying with maximum safety. Equipments in the above projects are required to support tactical/mobile needs of the Air Force. Microwave Landing System (MLS) avionics will support both fixed base and mobile MLS equipment. Some of these programs are not on contract, therefore, contractor estimates are not available for all of them.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 17,257 | 12,095 | 25,139 | Continuing | N/A |
| Aircraft Procurement | 0 | 0 | 9,200 | Continuing | N/A |
| Other Procurement | 0 | 1,100 | 740 | Continuing | N/A |

EXPLANATION: (U) FY 1988 RDT&E increase is the result of Congressional Committee increases: $4.0 for Project 2966 (New Mobile Rapcon). Funds are to be used to procure an operations shelter and continue system test; ; $4.0 for Project 2839 (ATC Survivability). Funds are to be used to continue development toward production; ; and $2.9 for Project 2759 (Mobile MLS). These funds were added to replace prior reductions. FY 1989 aircraft procurement was reduced by $3.5 (MLS Commercial Avionics) due to Air Force reductions.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement | 0 | 0 | 5,622 | 675,748 | 681,670 |
| (Various program elements): | | | | | |
| 3587 MLS Avionics | | | | | |
| Funds | 0 | 0 | 5,622 | 675,748 | 681,670 |
| Quantities | | | | | |
| Commercial Receiver | 0 | 0 | 160 | 2,440 | 2,600 |
| Military Standard Receiver | 0 | 0 | 0 | 7,700 | 7,700 |
| Operations and Maintenance | 0 | 0 | 0 | 285,000 | 285,000 |
| 3587 MLS Avionics | | | | | |
| Funds | 0 | 0 | 0 | 285,000 | 285,000 |
| Avionics Installation (Qty) | 0 | 0 | 0 | 10,300 | 10,300 |
| Other Procurement: | 0 | 1,100 | 740 | 272,700 | 272,700 |
| 2759 Mobile MLS | | | | | |
| Funds | 0 | 0 | 0 | 47,704 | 47,704 |
| Quantities | 0 | 0 | 0 | 60 | 60 |
| 3042 Bamboo Tree | | | | | |
| Funds | 0 | 1,100 | 740 | N/A | N/A |
| Quantities | 0 | TBD | TBD | N/A | N/A |

5. (U) RELATED ACTIVITIES: The Microwave Landing System (MLS) is a tri-Service program in which the Air Force is lead. The Air Force will consolidate DOD fixed base MLS requirements and acquire equipment concurrently with the Federal Aviation Administration (FAA). DOD will also develop a Mobile MLS (MMLS) for unique military applications. The Mobile MLS development will take advantage of the FAA fixed base design and the technology obtained from the Army's Joint Tactical MLS engineering development effort. The Global Positioning System (GPS) (PE 0305164F) will be investigated as an alternative to precision distance measuring equipment for MLS avionics installation. If GPS can be used for this function, considerable savings in avionics acquisition costs will be realized. The New Mobile Radar (NMR), surveillance radar subsystem is being procured jointly on the Marine Air Traffic Control And Landing System (MATCALS) contract. The Air Force has an option for 18 systems. The operation subsystem will use MATCALS as a basis for competitive procurement.

6. (U) WORK PERFORMED BY: Air Force Systems Command Electronic Systems Division, Hanscom AFB, MA, manages the overall TRACALS effort. ARINC Research Corporation, Annapolis, MD provides cost data for System Support (Project 2026) and also for the MLS (Projects 2759/3578); Mitre Corporation, Bedford, MA provides system support (Project 2026) and MLS technical support (Projects 2759/3578). Sperry Corporation will build the New Mobile Radar, radar subsystem (Project 2966).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2966, Rapidly Deployable Air Traffic Control System. The New Mobile Rapcon is the planned replacement for existing 1950 technology mobile systems. The number of units has been reduced from 25 to 18. In addition, the precision portion was deleted as the Mobile Microwave Landing System is the planned replacement for for 1-18 radar systems. Funds currently exist for a first article system. In FY 1987, preparation for competitive procurement began for the operations shelter using Marine Air Traffic Control And Landing Systems (MATCALS) development to the extent possible. An operational shelter would be procured and integrated with the radar in 1988-1989 Production would then follow. Prior year funding was deleted pending restructure of the program for a New Mobile Rapcon. These systems not only provide wartime restoral but are used in peacetime by Air National Guard Units, support exercises, deployments, and emergency mission support. The system will give increased capability in radar tracking to support higher density traffic, Electronic Counter Countermeasures, siting and Chemical Biological Radiation protection. The radar subsystem contract was awarded by the Navy to Sperry Corporation in July 1986.

B. (U) Project: 2026, System Support. This project provides planning support to all Traffic Control and Landing System acquisition projects managed by Air Force Systems Command including several joint efforts with the Federal Aviation Administration (FAA) which have no Air Force RDT&E funding. The project funds preprogram costing and definition efforts. FY 1987 efforts further define requirements for the New Mobile Rapcon (NMR) with the use of MATCALS development. In FY 1988 work will define how Air Force traffic control facilities in the United States will interface with FAA National Airspace System Plan initiatives. The work is essential to keep pace with new developments. New positioning/navigation aids such as Global Positioning System and the emerging FAA changes in the Air Traffic Control (ATC) structure require support definition. The effort will help assure Air Force operational capability in the ATC environment. This is a continuing program to keep pace with the civil airspace authority modernization.

C. (U) Project: 3042, Bamboo Tree. Bamboo Tree is the nickname for Air Force efforts to assure that the United States can maintain air access to fly the Berlin corridors. The Berlin radar automation program is complete. Integration with existing communication capabilities and problem resolution will be supported. This project has been programmed to provide continuing support to the Bamboo Tree mission. A continued effort is essential to maintain capabilities in the Berlin environment. Efforts will be directed toward defining an integrated air/ground communications capability. No new radios will be developed but the communication complex at Templehof Central Airport will require redesign to integrate the new families of radios developed under other programs into the complex.

D. (U) Project: 3587 Microwave Landing System Avionics. Under this project commercial MLS avionics will be modified and tested as necessary for integration and installation into cargo, tanker, training, bomber and operational support aircraft. Modifications will include a 1553B data bus capability, an off-set approach algorithm calculation and course softening for use with a collocated ground station. Also under this project a Military Microwave Landing System (MLS)/ Instrument Landing System (ILS) receiver will be developed for integration and installation on high performance aircraft. The overall MLS avionics architecture was reviewed by Office of the Secretary of Defense in Dec 1986 when OSD was briefed on the results of the MLS avionics architecture study initiated in FY 1985. The study addresses Microwave Landing System (MLS) receiver and ranging alternatives, antenna design and placement, aircraft integration, reliability/ maintainability and logistics support. During the transition period from the Instrument Landing System (ILS) to MLS, both systems will be maintained on the ground and in the aircraft. Once all aircraft are equipped with MLS, the ILS and Precision Approach Radar ground equipment and stand alone ILS avionics will be phased out. Evaluation of the modified Commercial Avionics will be completed and upon completion of the Military Avionics high reliability technology demonstration, the request for proposal for the full scale development of the Military Avionics will be prepared. Acquisition strategy is based on a competitive full scale development with fixed price production options. Cost estimates are based on an Air Force Systems Command Category IV Planning cost estimate.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2759, Mobile Microwave Landing System (MMLS).

A. (U) Project Description: The Mobile Microwave Landing System (MMLS) acquisition is part of a twenty year program to transition Air Force operations from use of Precision Approach Radar and the Instrument Landing System to the international standard Microwave Landing System (MLS) for all tactical and fixed base precision landing operations. This will require acquisition of both ground and airborne equipment. Acquisition will be paced to civil sector plans with most procurement and installation costs incurred in the 1988 to 1998 time frame. The International Civil Aviation Organization established MLS transition date is 1998. Transition to MLS provides for continued interoperability with civil landing systems, and NATO which through Standardization Agreement 4184 has also agreed to transition to Microwave Landing System (MLS) by 1998. The Mobile Microwave Landing System (MMLS) will be a modular, highly mobile system, weighing a maximum of 1000 pounds. It will specifically replace the mobile precision approach radar and provide a precision approach and landing capability to austere landing strips, bare base runways, and main operating bases as a back-up for Fixed Base MLS (FBMLS). MMLS will be used by Combat Communications Groups to support contingency operations, resupply, and medical evacuation. MMLS will also be used to support Quick Wartime Restoral of Tracals Equipment and Services (QWROTES) missions at main operating bases when FBMLS becomes non-operational. The overall MLS program includes development and procurement of the MMLS, procurement of the fixed base MLS which was developed by the FAA, and development and procurement of MLS avionics. The avionics effort is described in paragraph 7.D. project 3587.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In August 1987, the MMLS ground equipment request for proposal was released to industry.

(2) (U) FY 1988 Program: In FY 1988, the MMLS full scale development contract will be awarded and fabrication of the MMLS prototype ground equipment will begin. The MMLS cost estimate is based on an Air Force Systems Command Category IV Planning Cost estimate. Acquisition strategy includes a competitive full scale development with fixed price production options.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 fabrication of MMLS equipment will continue. The MMLS cost estimate is based on an Air Force Systems Command Category IV Planning Cost estimate. Acquisition strategy includes a competitive full scale development with fixed price production options.

(4) (U) Program to Completion: Through the year 2000 acquisition and installation of MLS avionics and ground equipment will continue. Eventually over 10,000 Air Force aircraft will be equipped with commercial or standard military Microwave Landing System (MLS) avionics and over 300 fixed/mobile ground systems will be deployed.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Mobile Microwave Landing System MLS (MMLS) Request for Proposal Release | *(March 1987) | August 1987 |
| (2) | (U) | Fixed Base MLS (FBMLS) Request for Proposal out | *(March 1987) | June 1988 |
| (3) | (U) | MMLS Contract Award | *(1st Quarter FY 1988) | February 1988 |
| (4) | (U) | FBMLS Contract Award | *(1st Quarter FY 1988) | 3rd Quarter FY 1989 |
| (5) | (U) | MMLS DT&E/IOT&E Complete<br>Development Test and Evaluation (DT&E)<br>Initial Operational Test and Evaluation (IOT&E) | *(2nd Quarter FY 1990) | 3rd Quarter FY 1990 |
| (6) | (U) | MMLS Production Decision | | 3rd Quarter FY 1990 |
| (7) | (U) | FBMLS Initial Operating Capability (IOC) | *(1st Quarter FY 1991) | 3rd Quarter FY 1992 |
| (8) | (U) | MMLS IOC | *(4th Quarter FY 1991) | 1st Quarter FY 1992 |
| (9) | (U) | FBMLS Ground Equipment Installation Complete | | 4th Quarter FY 1998 |

* Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) (U) MMLS Request for Proposal (RFP) Release slipped to align with Federal Aviation Administration (FAA) schedule for concurrent acquisition of fixed and MMLS equipment.
(2) (U) Fixed Base MLS RFP delayed by Congress.
(3) (U) MMLS contract award slipped to align with FAA schedule for concurrent acquisition of fixed and MMLS equipment.
(4) (U) Slipped because of delay in RFP release.

(5) (U) MMLS Request for Proposal (RFP) Release slipped to align with Federal Aviation Administration (FAA) schedule for concurrent acquisition of fixed and MMLS equipment.

(6) (U) MMLS DT&E/IOT&E slipped to align with FAA schedule for acquisition of fixed and MMLS equipment. However, acquisition strategy was changed when FAA Fixed Base MLS RFP was slipped again. The new date reflects the DOD MMLS schedule.

(7) (U) Slipped because of delay in RFP release.

(8) (U) MMLS Initial Operating Capability slipped due to delay in RFP release as stated above.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305164F — Title: Navstar Global Positioning System (User Equipment)
DOD Mission Area: 357 - Navigation and Position Fixing — Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 28,172 | 40,239 | 50,150 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element funds Research and Development to integrate Navstar Global Positioning System (GPS) user equipment into approximately 11,000 Air Force airborne and ground platforms. It also funds production and installation of GPS equipment and their associated support. Military forces need precise location data to enhance command and control and to engage in strategic and tactical warfare. A global, common grid positioning and navigation system is required to increase both accuracy and availability of current weapon systems, especially at night and in adverse weather. GPS improves our strategic target mapping capability, the probability of target acquisition, flexible routing, low-level ingress/egress, and accuracy of delivered weapons. These features, along with a capability for highly accurate passive operations, enhance the force effectiveness and survivability of many U.S. weapon systems. GPS satellites will also carry the Nuclear Detonation (NUDET) Detection System as an additional payload to detect and locate nuclear detonations. The GPS Mission Element Need Statement was revalidated by the Secretary of Defense at Milestone II in May 1979.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 28,972 | 45,801 | 61,697 | Continuing | N/A |
| Aircraft Procurement | 73,971 | 148,188 | 163,592 | Continuing | N/A |
| Other Procurement | 10,890 | 13,960 | 20,972 | Continuing | N/A |

EXPLANATION: (U) FY 1987 Other Procurement funding reflects adjustments for actual obligations. The FY 1988 RDT&E and Aircraft Procurement were reduced by Congressional actions. FY 1988 Other Procurement reflects adjustments to the spares account to assure proper logistical support. FY 1989 RDT&E, Aircraft Procurement and Other Procurement funding was adjusted by the Air Force to properly integrate funding with program requirements, consistent with budget constraints.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds | 73,970 | 117,433 | 114,917 | Continuing | N/A |
| Quantities (Receivers) | (212) | (356) | (452) | | |
| Other Procurement: | | | | | |
| Funds | 7,383 | 15,579 | 18,458 | Continuing | N/A |
| Quantities (Manpacks) | (151) | (288) | (375) | | |

5. (U) RELATED ACTIVITIES: The Global Positioning System (GPS) development and operational implementation is a joint program. Supporting activities of the Army, Navy, Marine Corps, Defense Mapping Agency, Department of Transportation and North Atlantic Treaty Organization (NATO) are coordinated through a Joint Program Office. Use of the GPS to provide guidance corrections for tactical missiles is being separately explored under PE 0603601F, Conventional Weapon Technology. Examination of advanced anti-jamming technology is conducted under PE 0603202F, Advanced Avionics for Aircraft. GPS also supports the Navy Fleet Ballistic Missile Programs (PE 0101221N, Fleet Ballistic Missile Systems) by providing test range positioning instrumentation. The NATO GPS project is a cooperative venture between the United States and ten NATO nations. This project provides information to these nations to assist them in making decisions about adopting the system for their military forces. Full Scale Development of user equipment was funded by all services under PE 0604777N and PE 0604778A/F, Navstar GPS, for the Navy, Army and Air Force, respectively. The Air Force funded initial satellite development and ground control segment development/deployment in PE 0604778F and production and operation in PE 0305165F. The Navy funds the development of clock technology used by both the satellite and control segment in PE 0604777N. Integration of user equipment into Army and Navy platforms (subsurface, surface and airborne) is funded in PE 0604778A and PE 0604777N, respectively. Procurement funding for Army and Navy equipments is in PE 0305164A and specific aircraft and ship program elements. The Nuclear Detonation (NUDET) Detection System (NDS) payload was flown on satellites 8, 9, 10 and 11. NDS will also be flown on all production satellites. PEs 0301357F and 0102433F, Nuclear Detonation Detection System, fund NDS payloads. Expendable launch services (Delta II) are funded under PE 0305119F, Space Boosters. Space Shuttle launches and Payload Assist Module Delta Class II (PAM-DII) upper stages are funded under PE 0305171F, Space Launch Support. The Consolidated Space Operations Center, which hosts the operational GPS Master Control Station, is funded under PE 0305130F.

6. (U) WORK PERFORMED BY: The Joint Program Office is located at the Air Force Systems Command's Space Division, Los Angeles AFB, CA. User equipment is produced by Rockwell International, Collins Government Avionics Division, Cedar Rapids, IA. Aerospace Corp., El Segundo, CA, provides technical and engineering support. Intermetrics,

Cambridge, MA is the user equipment software independent verification/validation contractor. The Naval Air Development Center, Warminster, PA: the Naval Avionics Center, Indianapolis, IN; and the Army Avionics Research and Development Activity, Ft Monmouth, NJ, are providing technical and validation support to the program office for joint service user equipment development and production.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0305164F, Navstar Global Positioning System (GPS) (User Equipment)

A. (U) Project Description: The GPS is a space-based radio positioning and navigation system designed to provide worldwide, all weather, three-dimensional position (16 meter Spherical Error Probable), velocity (0.1 meter/sec) and precise time (within 0.1 microsecond). GPS provides a common navigation grid for land, air and sea units for coordinated operations. GPS consists of three segments. The space segment (funded in PE 0305165F) produces the worldwide navigation signals. It consists of an 18-satellite constellation plus three on-orbit spares. The control segment (also funded in PE 0305165F) consists of five Monitor Stations and three ground antennas (located around the world) and a master control station (MCS), which is located in the Consolidated Space Operations Center. The Monitor Stations measure satellite performance parameters which are evaluated by the MCS and then corrected as necessary using the ground antennas. The user segment consists of the electronic equipment and interfaces necessary to receive and process GPS satellite signals into position, velocity, and time data for various military users. This project develops the capability to integrate GPS user equipment into Air Force airborne and ground systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Development of the GPS standard interface was completed, and initial set deliveries began in August. Development of software modifications for the B-52G, E-3A and F-111 family of aircraft continued, and integration planning/software development activities for the C-130 family and for the MH-53J were initiated. Development of depot training equipment and simulators was also initiated.

(2) (U) FY 1988 Program: Development of integration software for the F-111 A/E, B-52G and RC-135 will be completed and other previously initiated efforts will continue. Integration efforts will begin for the F-16 family, F-4 family, A-10, MH-60, E-8, B-1B, KC-135, and KC-10. Development of depot training equipment and simulators continues. This line also funds follow-on user equipment testing in preparation for the start of full rate production in FY 1990. Cost estimates for the standard interface are based on negotiated contracts and are category I, comprehensive, estimates. Cost for user equipment integration including software modifications are based on preliminary Modification Proposal Analyses conducted by Air Force Logistics Command (AFLC) and are category II, mature, estimates. Integration study estimates are based on preliminary AFLC (category IV) planning estimates.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of integration software for initial C-130 family aircraft will be completed and other ongoing integration efforts will continue. Integration preparations will be initiated for the F-15 family, additional C-130 family aircraft, UH-1, C-141B, WC-135 and EC-135. Development of depot training equipment and simulators continues. Follow-on testing will be completed in preparation for a full-rate production decision in FY 1989. The same cost estimate categories apply as in FY 1988.

(4) (U) Program to Completion: This is a continuing program. Effort will continue beyond the year 2000 to integrate GPS into all United States Air Force (USAF) aircraft to support world-wide navigation in lieu of other proliferated radio navigation systems.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Defense Systems Acquisition Review Council (DSARC) II | | May 1979 |
| (2) | (U) | Begin Satellite Production (PE 0305165F) | | September 1982 |
| (3) | (U) | Begin User Avionics Initial Operational Test and Evaluation (PE 0604778F) | | November 1984 |
| (4) | (U) | Joint Requirements and Management Board (JRMB) IIIA (PE 0305164F) | | June 1986 |
| (5) | (U) | Begin User Avionics Limited Production (PE 0305164F) | | August 1986 |
| (6) | (U) | Defense Acquisition Board IIIB (PE 0305164F) | | FY 1989 |
| (7) | (U) | Launch First Operational Satellite (PE 0305165F) | | 1st Quarter FY 1989** |
| (8) | (U) | Achieve Worldwide 2-D Capability (PE 0305165F) | *(4th Quarter FY 1989) | 4th Quarter FY 1990** |
| (9) | (U) | Achieve Worldwide 3-D Capability (PE 0305165F) | *(4th Quarter FY 1990) | 4th Quarter FY 1991** |

* Date presented in FY 1988/FY 1989 Descriptive Summary
** Launch schedule dependent.

(U) Explanation of Milestone Changes:

(8) (9) (U) Launch schedule normalized to assure consistent, supportable constellation build and to smooth resulting satellite replenishment requirements.

9. (U) COOPERATIVE AGREEMENTS: In April, 1978, a Memorandum of Understanding (MOU) was signed with nine NATO allies and with Australia to permit NATO and Australian participation in the development of GPS user equipment. The MOU created an international team at the US Joint Program Office (JPO) in California, with each nation providing representatives to the JPO. Nations involved include Britain, Norway, the Netherlands, Italy, Germany, France, Denmark, Canada, Belgium and Australia. Also, during 1987, Spain became the tenth NATO signatory to the MOU. Allied personnel are fully integrated into the user equipment, program management, and operational applications functional areas of the JPO. They have supported Navstar activities during user equipment Full-Scale Engineering Development and will continue their roles as the program progresses into Low-Rate Initial Production leading to the full-rate production decision planned in FY 1989.

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305165F
DOD Mission Area: 357 - Navigation and Position Fixing

Title: Navstar Global Positioning System (GPS) (Space/Ground Segments)
Budget Activity: 5-Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 35,917 | 26,204 | 53,232 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the Navstar GPS satellite and control segments of the overall GPS program. This includes: satellite development, procurement, deployment; operation of the ground control segment; preplanned product improvements to improve survivability of both the space and control segments; and R&D efforts to support deployment of the entire GPS system. Military forces need to know precise location data to enhance command and control and to engage in strategic and tactical warfare. A global, common grid positioning and navigation system is required to increase both accuracy and availability of current weapon systems especially at night and in adverse weather. GPS improves our strategic target mapping capability, the probability of target acquisition, low-level ingress/egress, flexible routing, and the accuracy of delivered weapons. These features, along with a capability for highly accurate passive operations, enhance the force effectiveness and survivability of many U.S. weapon systems. GPS satellites will also carry the Nuclear Detonation (NUDET) Detection System as an additional payload to detect and locate nuclear detonations. The GPS Mission Element Need Statement was revalidated by the Secretary of Defense at Milestone II in May 1979.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 36,305 | 26,309 | 61,257 | Continuing | N/A |
| Missile Procurement | 128,527 | 92,605 | 61,217 | Continuing | N/A |
| Other Procurement | 3,925 | 3,807 | 0 | Continuing | N/A |

EXPLANATION: (U) Funding changes in FY 1989 RDT&E reflect a rephased competitive satellite development program supporting the production of GPS replenishment satellites and extended development support for the control segment. Changes in FY 1987 and FY 1989 Missile Procurement permit restructuring of the multiyear production satellite contract to more closely align satellite deliveries with the launch schedule.

Program Element: 0305165F
DOD Mission Area: 357 - Navigation and Position Fixing

Title: Navstar Global Positioning System (GPS) (Space/Ground Segments)
Budget Activity: 5 - Intelligence and Communications

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Funds (GPS Satellites) | 78,233 | 92,605 | 75,644 | Continuing | N/A |
| Quantities (Order/Full Fund) | (0/8) | (0/4) | (0/0) | | |
| Other Procurement: | | | | | |
| Funds | 3,631 | 4,008 | 907 | 0 | 8,600 |
| Quantities | Not Applicable | | | | |

5. (U) RELATED ACTIVITIES: The GPS development and operational implementation is a joint program. Supporting activities of the Army, Navy, Marine Corps, Defense Mapping Agency, Department of Transportation and North Atlantic Treaty Organization (NATO) are coordinated through a Joint Program Office. Use of the GPS to provide guidance corrections for tactical missiles is being separately explored under PE 0603601F, Conventional Weapons Technology. Investigation of advanced antijamming technology is conducted under PE 0603203F, Advanced Avionics for Aircraft. GPS also supports the Navy's Fleet Ballistic Missile Programs (PE 0101221N, Fleet Ballistic Missile Systems) by providing test range positioning instrumentation. A NATO contingent provides information to NATO nations to assist in making decisions about adopting the system for their military forces. Full Scale Development of user equipment was funded by all services under PEs 0604777N and 0604778A/F, Navstar GPS for the Navy, Army and Air Force, respectively. The Air Force funded initial satellite development and ground control segment development/deployment in PE 0604778F. The Navy funds the development of clock technology used by both the satellite and control segment in PE 0604777N. RDT&E and procurement funds to integrate GPS avionics in Air Force ground and airborne platforms are in PE 0305164F, Navstar GPS User Equipment and specific aircraft program elements. Integration of user equipment into Army and Navy platforms (subsurface, surface, and airborne) is funded in PE 0604778A and PE 0604777N, respectively. Procurement funding for Army and Navy equipment is in PE 0305164A/N and specific aircraft and ship program elements. The Nuclear Detonation (NUDET) Detection System (NDS) payload was flown on satellites 8, 9, 10 and 11. NDS will also be flown on all production satellites. PEs 0301357F and 0102433F, Nuclear Detonation Detection System, fund NDS payloads. Expendable launch services (Atlas E/F (used to launch the last development GPS satellite) and the Delta II (Medium Launch Vehicle)) are funded under PE 0305119F, Space Boosters. Space Shuttle launches and Payload Assist Module Delta Class II (PAM DII) upper stages are funded in PE 0305171F, Space Launch Support. The Consolidated Space Operations Center which hosts the operational GPS Master Control Station, is funded in PE 0305130F.

6. (U) WORK PERFORMED BY: The Joint Program Office is located at the Air Force Systems Command's Space Division, Los Angeles AFB, CA. The satellite contractor is Rockwell International Space Operations and Satellite Systems

Division, Seal Beach, CA. International Telephone and Telegraph, Nutley, NJ, and Rockwell International/Autonetics Strategic Systems Division, Anaheim, CA, are the subcontractors for the navigation subsystems. Aerospace Corp., El Segundo, CA, provides technical and engineering support. User Equipment is produced by Rockwell International Collins Government Avionics Div., Cedar Rapids, IA. Operational Control Segment development/deployment is being done by International Business Machines/Federal Systems Div., Gaithersburg, MD.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0305165F, Navstar Global Positioning System (Space/Ground Segments):

A. (U) Project Description: The Navstar GPS is a space-based radio positioning and navigation system designed to provide worldwide, all weather, three-dimensional position (16 meter Spherical Error Probable), velocity (0.1 meter/sec) and precise time (within .1 microsecond). GPS provides a common navigation grid for land, air and sea units for coordinated operations. GPS consists of three segments. The space segment produces the worldwide navigation signals. It consists of the 18 satellite constellation plus three on-orbit spares. The control segment consists of five monitor stations and three ground antennas (located around the world) and a Master Control Station (MCS), which is a tenant in the Consolidated Space Operations Center. The monitor stations measure satellite performance parameters which are evaluated and corrected by the MCS and then forwarded to the satellites by the Ground Antennas. The user segment (funded by PE 0305164F) consists of the avionics and interfaces necessary to receive and process GPS satellite signals into position, velocity, and time data for various military users.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Control segment activities supporting the GPS development satellites continued. Control segment software modifications to accommodate full operation with the GPS production satellites including the Nuclear Detonation (NUDET) Detection System (NDS) electromagnetic pulse sensor also continued. This includes software rehosting to allow operation on Consolidated Space Operations Center standard IBM 3083 Computers. Navigation data message processing techniques were demonstrated which permit extended GPS navigation without frequent control segment update. Engineering efforts continued supporting preparations for the launch of the first GPS production satellite. Efforts began to develop second sources for improved key satellite payload boxes. This development activity will become the basis to compete the GPS replenishment satellite development/production effort. GPS/Delta II interface compatiblity and launch support engineering efforts continued.

(2) (U) FY 1988 Program: Control segment activities supporting the GPS development satellites will continue. Control Segment software development for the GPS production satellites (including the NDS sensor package) will be completed and the operational software will be delivered. Engineering efforts will continue supporting the first launch of a GPS production satellite. GPS/Delta II interface compatibility engineering efforts will continue.

The second source effort begun in FY 1987 will conclude. This will then provide the industrial base for the development and procurement of GPS replenishment satellites. Control segment and satellite costs are based on similar previous development efforts and negotiated contracts, and are category II, mature, cost estimates.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Control segment activities supporting the GPS development and production satellites (as they are launched) will continue. System level Developmental Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) of control segment software will begin as production satellites are launched. The development of the GPS replenishment satellites will begin. Engineering activities supporting the launch of GPS production satellites will continue. The cost category for current satellite and control segment activities is the same as FY 1988. Replenishment satellite system design activities represent Category III, budgetary, cost estimates.

(4) (U) Program to Completion: This is a continuing program. Support of the GPS satellite constellation will continue. Deployment of production satellites will continue. Development and deployment of GPS replenishment satellites will continue. System engineering to support the growing community of GPS users will be required.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Defense Systems Acquisition Review Council (DSARC) II | | May 1979 |
| (2) | (U) | Begin Satellite Production (PE 0305165F) | | September 1982 |
| (3) | (U) | Begin User Avionics Initial Operational Test and Evaluation (IOT&E) (PE 0604778F) | | November 1984 |
| (4) | (U) | DSARC IIIA (PE 0305164F) | | June 1986 |
| (5) | (U) | Begin User Avionics Limited Production (PE 0305164F) | | August 1986 |
| (6) | (U) | Launch First Satellite | | 1st Quarter FY 1989** |
| (7) | (U) | Achieve Worldwide 2-Dimensional Capability | *(4th Quarter FY 1989) | 4th Quarter FY 1990** |
| (8) | (U) | Achieve Worldwide 3-Dimensional Capability | *(4th Quarter FY 1990) | 4th Quarter FY 1991** |

* Dates presented in FY 1988/FY 1989 Descriptive Summary.
** Launch schedule dependent.

(U) Explanation of Milestone Changes

(7) (8) (U) Launch schedule normalized to assure consistent, supportable constellation build and to smooth resulting satellite replenishment requirements.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603402F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Space Test Program (STP)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 49,093 | 53,887 | 72,796 | Continuing | N/A |
| 2617 | Free-Flyer Spacecraft Missions | 24,589 | 29,527 | 27,849 | Continuing | N/A |
| 2618 | Quick Response Shuttle Missions | 512 | 1,104 | 4,003 | Continuing | N/A |
| 2619 | Teal Ruby Mission | 11,794 | 11,987 | 25,276 | 36,172 | 278,963 |
| 2620 | Shuttle Sortie Missions | 12,198 | 11,269 | 15,668 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Space Test Program (STP) advances DOD technology by providing spaceflight missions for experiments that demonstrate new space system technologies, concepts, and designs and for experiments that determine space environmental effects on DOD space systems. This tri-Service program provides the only substantial spaceflight capability to perform fly-before-buy demonstrations of advanced technology designs. These experiments are flown based on relevance to existing military requirements and the availability of cost effective means of spaceflight on expendable launch vehicles or Shuttle. The STP is the pathfinder for exploiting the Shuttle as a manned DOD space laboratory to expedite the infusion of new technology into space systems through the use of simpler, incrementally designed, man-aided experiments. The experience gained from this approach will be a key element in fully defining military man's role in space.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 49,219 | 90,197 | 130,664 | Continuing | N/A |

EXPLANATION: FY 1988 funds were reduced based on Congressional action. FY 1989 and outyear budgets were level funded. These budget reductions will require the termination of the P86-2, Starscan contract; cancellation of the P87-B mission which would demonstrate an advanced technology clock for the Global Positioning System; and delay of future missions on Scout-class expendable launch vehicles and government/commerical space platforms.

4. (U) OTHER APPROPRIATIONS FUNDS: Not Applicable

5. RELATED ACTIVITIES: Expendable launch vehicles and their corresponding launch support are funded by STP and procured through Space Boosters, PE 0305119F. Space Shuttle launch support is provided by Space Shuttle Operations, PE 0305171F. Host satellites for STP payloads include the Defense Meteorological Satellite Program, PE 0305160F; National Aeronautics and Space Administrations's (NASA) Long Duration Exposure Facility; Navy Transit; NASA's Tracking and Data Relay Satellite; National Oceanic and Atmospheric Administration's (NOAA) Television Infra-Red Observation Satellite an Geosynchronous Operational Environmental Satellite; and classified programs. Payloads are supported by the following: Office of Naval Research; Naval Research Laboratory; Defense Nuclear Agency; Air Force Academy; Naval Post Graduate School; Naval Air Systems Command; Space and Naval Warfare Systems Command; Army Atmospheric Sciences Laboratory; [ ] Defense Advanced Research Projects Agency; NASA; Defense Research Sciences, PE 0601102F; Geophysics, PE 0602101F; Materials, PE 0602102F; Aerospace Propulsion PE 0602203F; Advanced Weapons, PE 0602601F; Space Communications, PE 0603432F and [ ] Memorandum of Agreements (MOAs) exist between the Air Force and NASA's Goddard Space Flight Center and Marshall Space Flight Center, NOAA, Defense Advanced Research Projects Agency, Defense Nuclear Agency, Naval Research Laboratory, the Army's Engineering Topographic Laboratory. MOAs exist with Great Britain, Canada and Australia for the Teal Ruby program.

6. (U) WORK PERFORMED BY: The Air Force Systems Command's Space Division, Los Angeles AFS, CA, is responsible for spaceflight planning, engineering, procurement, and operational aspects required to execute the Space Test Program (STP). Systems engineering support is provided by the Aerospace Corporation, Los Angeles, CA. Current payload integration and/or spacecraft contractors are Rockwell International, Seal Beach, CA (P888, Teal Ruby/P80-1 spacecraft); Lockheed Missiles and Space Company, Sunnyvale, CA (P675, Cryogenic Infrared Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS) spacecraft); Ball Aerospace, Boulder CO (P86-1, Combined Release and Radiation Effects Satellite and P86-2, Starscan); through Naval Space and Warfare Command (P87-2, Stacksat - previously known as the Polar Orbiting Mission); NASA's Goddard Space Flight Center, Greenbelt, MD (Spartan experiment carrier) and through NOAA, General Electric, Astro-Space Division, Princeton, NJ (TIROS host vehicle for three prototype environmental sensors).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2618, Quick Response Shuttle Missions. This STP project supports the flight of Quick Response Shuttle Payloads and military man in space demonstrations. These experiments maximize near-term flight opportunities on both DOD and NASA Space Transportation System missions by making use of available space in Shuttle mid/aft-deck lockers. They are designed to evaluate man's ability to meet unique DOD research and development as well as operational requirements. A total of thirteen experiments were flown prior the Challenger accident in January 1986. Forty-three experiments are manifested or awaiting flight. In FY 1988 and FY 1989, with the resumption of Shuttle flights, STP will provide experiment integration support and personnel training. This is a continuing program. STP program personnel are developing cost estimating capabilities as they gain experience in integration and operations activitie associated with these type of payloads. Due to the unique nature of these experiments, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2617, Free-Flyer Spacecraft Missions

A. (U) Project Description: This STP project advances DOD space technology by providing for the spaceflight of DOD prioritized experiments on STP developed free-flyer spacecraft. These flights are used for the demonstration of new system technologies, concepts and designs and for determining space environmental effects on military space systems. Expendable launch vehicles and their corresponding launch support are procured through Space Boosters, PE 35119F with STP appropriated funds. Shuttle launch support tasks are provided by PE 0305171F, Space Shuttle Operations. This project supports spacecraft development for the joint DOD (Air Force)/National Aeronautics and Space Administration's (NASA) Combined Release and Radiation Effects Satellite (CRRES) mission, the joint Air Force/Defense Nuclear Agency's Polar Beacon Experiment and Auroral Research (Polar BEAR) satellite, the STP/Defense Advanced Research Projects Agency's (DARPA) Starscan mission, and the joint Air Force/Navy's Stacksat mission. In addition, this project supports the integration and spaceflight of secondary payloads on free-flyer host spacecraft. These secondary payloads include three Navy sponsored environmental prototype sensors to be flown on the National Oceanic and Atmospheric Administration's (NOAA) Television Infra-Red Observation Satellites (TIROS); the Advanced Clock and Ranging Experiment (ACRE) on a Global Positioning System (GPS) qulification satellite and a space charge control system to be flown on NOAA's Geostationary Operational Environmental Satellite (GOES).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The Polar BEAR mission was launched on 13 November 1986 aboard a Scout expendable launch vehicle. STP supported Polar BEAR on-orbit operations and data collection. CRRES completed final acceptance testing and was placed in storage at the contractor's facility awaiting a launch. Due to reduced STP FY 1987 funding, the Starscan spacecraft development and integration contract, award was delayed until June FY 1987. In addition, the FY 1987 Titan II launch vehicle funding for Starscan was delayed until FY 1988. Integration of the three environmental monitoring experiments the on TIROS began. Initial planning for the Stacksat mission was begun, although contract award was delayed until FY 1988. The Atlas launch vehicle funding for Stacksat was delayed until FY 1988. Planned feasibility studies for ACRE using the GPS qualification satellite began. A feasibility study was initiated with NOAA to fly an active space charge control system on their GOES.

(2) (U) FY 1988 Program: STP launched the DARPA-sponsored Gamma-ray Advanced Detector (GRAD) space experiment on 8 January 1988 using a high altitude balloon. The launch, from McMerdo Sound, Antarctica, allowed the GRAD detectors to be validated by sensing gamma-rays emitted from a super nova. Polar BEAR on-orbit operations and support will continue. CRRES will be removed from storage and undergo systems level tests to ensure its readiness for an Atlas-Centaur launch in FY 1990. Due to the significant reduction in the FY 1988 President's Budget request, the Starscan spacecraft development and integration contract will be terminated. Procurement of the Titan II for this mission will also be terminated. The integration of the three environmental monitoring experiments on TIROS will continue with a

planned completion in FY 1989. The integration and acceptance testing of Stacksat spacecraft and the three experiments will continue. The Atlas launch vehicle procurement will also continue. The feasibility study for ACRE and other STP prioritized experiments will be cancelled due to the FY 1988 budget reduction. The active space charge control system will begin initial integration on the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite (GOES). Planned studies identifying spacecraft designs compatible with existing expendable launch vehicles will not be accomplished.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Stacksat will conclude testing and be launched from Vandenberg AFB, CA, in March 1989 by an Atlas launch vehicle. The Combined Release and Radiation Effects Satellite (CRRES) will conclude reacceptance testing and be prepared for shipment to Kennedy Space Center, FL, in preparation for the FY 1990 Atlas-Centaur launch. The integration of the three environmental experiments on NOAA's Television Infra-Red Observation Satellites (TIROS) will be completed and will be placed into storage while TIROS awaits an operational requirement to launch. The active space charge control system will complete integration aboard the GOES and also await an operational requirement to launch. Planning for the next polar orbiting mission and launch vehicle will begin. The cost estimating techniques used for the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation models, contractor estimates and a large data base of experience from previous STP free-flyer spacecraft missions. Due to the differing levels of mission maturity, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

(4) (U) Program to Completion: This is a continuing program. This on-going project will continue to provide free-flying spacecraft and integration for DOD prioritized space demonstration which are not authorized their own means to space. STP will use both Shuttle and expendable launch vehicle opportunities based on cost, schedule and overall mission requirements.

C. (U) Major Milestones:

| Milestones | | Date |
|---|---|---|
| (1) (U) Successful Scout launch of P87-1, Polar Beacon Experiment and Auroral Research satellite | | 13 November 1986 |
| (2) (U) Balloon launch of P87-3, Gamma-Ray Advanced Detector | | 8 January 1988 |
| (3) (U) Atlas launch of P87-2, Stacksat | | FY 1989 |
| (4) (U) Atlas-Centaur launch of P86-1, CRRES | *(FY 1989) | FY 1990 |
| (5) (U) Titan II launch of TIROS with three secondary experiments | | To Be Determined |
| (6) (U) Launch of GEOS with the space charge control experiment | | To Be Determined |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes
(4) (U) Launch schedule delayed due to Challenger accident and procurement of the Atlas-Centaur.

Program Element: 0603402F | Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support | Budget Activity: 6 - Defense-Wide Mission Support

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2619, Teal Ruby Mission

A. Project Description: This project supports the development of an STP spacecraft (P80-1) for the Defense Advanced Research Projects Agency (DARPA)/Air Force Teal Ruby Mission (P888). The Teal Ruby mission, known by its primary DARPA payload of the same name, also carries Army, Navy and National Aeronautics and Space Administration (NASA) secondary payloads. The DARPA experiment will demonstrate new infrared technologies and collect data needed for the design of future During the eleven months of operation, the Teal Ruby sensor will execute over 100 missions involving more than 240 targets. The three secondary payloads operating for up to three years include - a NASA designed ion thruster experiment testing capabilities for long-term satellite station-keeping; a Navy autonomous spacecraft navigation experiment; and an Army ultraviolet spectrometer experiment studying the space ultraviolet spectrum.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The Teal Ruby spacecraft remained in storage at the contractor's facility due to the Shuttle standdown. The Shuttle delay required certain spacecraft components to be replaced and the uplink/downlink software to be modified to be compatible with the Air Force Satellite Control Facility's new Data System Modernization. The feasibility of on-orbit servicing of the five gases onboard the Teal Ruby spacecraft and cryostat was initiated. Spacecraft refueling could double the on-orbit lifetime of the cryostat. Mission planning for the East Coast Shuttle launch continued.

(2) (U) FY 1988 Program: Teal Ruby was manifested for a Shuttle flight in FY 1990. Teal Ruby will remain in storage except during periodic health checks. The mission planning and operations software modifications will continue. Life-limited components will be procured for replacement prior to flight. The on-orbit servicing study will be completed and if necessary, spacecraft modifications will be initiated.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Teal Ruby spacecraft and sensor will be removed from storage, reintegrated, and retested in preparation for the FY 1990 Shuttle launch. Contractor personnel released during the storage period will be rehired and retrained. All personnel will complete system training and flight recertification. Mission planning and software modifications will be completed and used during the personnel retraining. The cost estimating techniques used by the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation models, contractor estimates and a large data base of experience from previous STP free-flyer spacecraft missions. Since the costs of the remaining Teal Ruby activities are already on contract, the cost estimating range is category I (Comprehensive).

(4) (U) Program to Completion: Teal Ruby is planned to be launched in FY 1990. Reacceptance testing and launch readiness will conclude in FY 1990. After launch, data will be collected from the Teal Ruby sensor for up to

one year (or two years if the spacecraft is refueled) and from the three secondary experiments for three years.

C. (U) Major Milestones:

| Milestones | | Date |
|---|---|---|
| (U) Teal Ruby launch on Shuttle | *(FY 1991) | FY 1990 |

*Data presented in the FY 1988/FY1989 Descriptive Summary

(U) Explanation of Milestone Changes
(U) Shuttle launch manifest changed to accommodate Teal Ruby.

10. (U) PROJECT OVER $10 MILLION IN FY 1988/OR FY 1989:

(U) Project: 2620, Shuttle Sortie Missions

A. (U) Project Description: This STP project advances DOD space technology by providing for the spaceflight of experiments on Shuttle sortie missions (payloads/experiments remain in the Shuttle and are returned) for demonstrating new system technologies, concepts, and designs and for determining space environmental effects on military space systems. Through sortie missions using generic reusable, standard STP Shuttle experiment support equipment, STP accomplishes its pathfinder role of exploiting the Shuttle as a manned DOD space laboratory. The project supports the flight of secondary experiments in National Aeronautics and Space Administration's (NASA) Get-Away-Special (GAS) canisters and on other Shuttle bay support structures such as Sortie Pallet for Shuttle (SPAS), Spartan, Hitchhiker-G and Hitchhiker-M being flown in the Shuttle sortie mode. The project provides for the procurement of generic reusable experiment support equipment; integration of sortie mission payloads with the Shuttle experiment support equipment and the integration of the combination into the Shuttle; mission/payload specialist training on STP hardware; launch support; on-orbit support and Aerospace Corporation systems engineering support. Specifically, this project currently supports the Cryogenic Infrared Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS) mission, Air Force Program 675 (P675). P675 proof-of-concept data will support decisions on future Air Force and Strategic Defense Initiative Organization programs. P675 is planned for an FY 1990 launch.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Due to the Shuttle standdown, the CIRRIS 1A/ESS and the secondary experiments remained in storage. Mission replanning continued. Only essential contractor personnel were maintained. Secondary experiments were returned to the sponsors for upgrading and/or testing. Construction of a second generation Spartan reuseable experiment carrier and its Shuttle support structure was initiated with the NASA's Goddard Space Flight Center later than planned due to the reduced FY 1987 Congressional appropriation. STP procurement of the SPAS was delayed until FY 1988 due to reduced FY 1987 funding. Identification, planning and procurement of generic equipment such as a large GAS canister capable of deploying small spacecraft was also delayed until FY 1988 due to

limited funds. Technical management support for the entire Program Element was funded in this project.

(2) (U) FY 1988 Program: The Cryogenic Infrared Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS) pallet was manifested for a Shuttle flight in FY 1990. The CIRRIS 1A/ESS contractor support team will be reconstituted. The CIRRIS 1A/ESS pallet will be removed from storage and readied for reintegration of the experiments. Mission replanning for an East Coast launch will continue. Integration of the STP experiments onto the Spartan experiment carrier will begin. Procurement of a Sortie Pallet for Shuttle (SPAS) will be delayed until FY 1989 due to the significant FY 1988 budget reduction. Aerospace Corporation technical support is funded in this project.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The CIRRIS 1A/ESS pallet will be retested and recertified for spaceflight. The experiments will be redelivered by the sponsors and reintegrated on the pallet. After the reconstitued contractor support team is retrained and recertified the entire pallet will reaccomplish acceptance level testing including thermal vaccuum testing. The integration of the Spartan experiment carrier will conclude. Procurement of the SPAS will commence. SPAS will be avaliable for launch in FY 1992. SPAS is designed to carry up to 2000 pounds of experiments and fly free of the Shuttle for up to 40 hours. Aerospace Corporation technical support and program office support for the entire Program Element are funded in this project. The techniques used by the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation model and contractor estimate. Since no significant pricing data base exist for Shuttle sortie type missions, personnel are developing cost estimating capabilities as they gain experience in Shuttle integration and operation activities. Therefore, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

(4) (U) Program to Completion: This is a continuing program. CIRRIS 1A/ESS is manifested to be launched in FY 1990. This project will continue to provide spaceflights for DOD space experiments on Shuttle sortie opportunities based on integration cost, Shuttle manifest and mission requirements. Development and upgrade of generic experiment support equipment which increases flight opportunities and reduces flight costs will continue. Initial studies will be conducted on the equipment necessary to make use of the National Aeronautics and Space Administration's Orbital Maneuvering Vehicle and the Space Station for DOD experiments. Spartan and SPAS will provide spaceflight opportunities for DoD experiments in FY 1990 and FY 1991, respectively and one flight per year thereafter. STP will continue to evaluate the Industrial Space Facility and other commerical platforms for demonstration of DOD space experiments.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Shuttle sortie mission of CIRRIS 1A/ESS | | FY 1990 |
| (2) (U) Shuttle sortie mission of Far Ultraviolet Imaging Spectrometer and Star Tracker on Spartan | *(FY 1989) | FY 1990 |
| (3) (U) Shuttle sortie mission of the reflight of Spartan | *(FY 1990) | FY 1991 |
| (4) (U) Shuttle sortie mission of SPAS | *(FY 1990) | FY 1992 |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestones Changes

(2) and (3) (U) Shuttle schedule delayed due to the Challenger accident.
(4) (U) Delay caused by reduced funding.

11. (U) COOPERATIVE AGREEMENTS: Agreements exist with Great Britain, Canada and Australia for the Teal Ruby mission. These participants have agreed to provide targets of opportunity as well as members of their Air Forces to plan these missions. In return, they will receive only the mission data related to their targets. This is the only cooperative agreement with foreign participants in which STP is involved.

## AMENDED FY 1988/FY 1989 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603438F  Title: Satellite Systems Survivability
DOD Mission Area: 410 - Space Launch and Orbital Support  Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 1,886 | 3,264 | 3,784 | Continuing | N/A |
| 2611 | Survivability Planning and Analysis | 50 | 200 | 200 | Continuing | N/A |
| 2612 | Satellite Survivability | 1,836 | 2,964 | 3,484 | Continuing | N/A |
| 2613 | Ground Station/Link Survivability | 0 | 100 | 100 | Continuing | N/A |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program performs survivability planning and analysis and develops the necessary prototype hardware, software, technology, operational procedures, strategy, and tactics that will provide generic survivability capabilities for the military space systems of the United States. The program is structured to provide balanced survivability between all space systems elements: satellites, data/command links, and ground stations. Space systems are required to provide critical strategic and tactical support to national decision makers and military force commanders at all levels of conflict. They specifically provide missile attack warning, strategic and tactical navigation, surveillance, communications, and meteorological information. These systems provide support to strategic, tactical, and Rapid Deployment Forces on a global basis.

Failure to protect our space systems will result in the denial of their critical support to the National Command Authorities and our military forces during crisis and conflict. The major development effort within this program is the Satellite On-Board Attack Reporting System (SOARS).

Survivability technologies under this program are made available to all satellite program offices for system level implementation.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 1,933 | 3,277 | 3,787 | Continuing | N/A |

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4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Strategic Defense Initiative (SDI) Support Programs (PE 0603224C) contain a Survivability Project (#0010). This program element is managed by the Department of Defense and the Air Force which is the lead Service for the survivability project. Efforts in the SDI Support Programs complement work in this program element. PE 0602601F, Advanced Weapons, and PE 0604711F, Systems Survivability, develop nuclear hardening technology which is applied in PE 0603438F. PE 0603431F, Advanced Space Communications Capabilities, develops communication systems technology which supports survivable tracking, telemetry, and control (TT&C) stations. PE 0603211F, Aerospace Structures and Materials, develops laser-hardened satellite components and materials.

6. (U) WORK PERFORMED BY: The Air Force Systems Command's Space Division, Los Angeles AFS, CA has overall responsibility for program management. Space Division executes the program, has responsibility for contractor overview and performs technical analysis in support of all projects. General Research Corp, Santa Barbara, CA, is the contractor for survivability planning and analysis. The Satellite On-Board Attack Reporting System (SOARS) design phase contracts are with Lockheed, Sunnyvale, CA, and TRW, Los Angeles, CA. The Aerospace Corporation, Los Angeles, CA, provides system engineering support and developing technology for the Configuration Enhanced Radiation Rejection (CERR) effort.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2611, Survivability Planning and Analysis. This project reviews the mission requirements for Department of Defense space systems, evaluates their vulnerability to current and future threats, and determines the most cost-effective methods to achieve required survivability. The results of these reviews and evaluations are published annually in a document called the Space Mission Survivability Plan. Development of long-term survivability criteria and investment strategies for DOD space systems, which are responsive to the growing threat, continued in FY 1987. FY 1988 and FY 1989 activities will include annual updates of the Space Mission Survivability Plan to reflect the continued evolution of the threat, technology requirements, development priorities, and operational needs. New initiatives will also be developed as appropriate.
This is a continuing program.

B. Project: 2612, Satellite Survivability. This project develops prototype survivability technologies for deployment in the 1990s, to protect those U.S. satellites critical to our national defense. It develops prototype system level capabilities to counter the demonstrated conventional co-orbital, and the potential direct-ascent nuclear and laser antisatellite threats to DOD satellites. The project also demonstrates sensor survivability and laser hardening techniques necessary to protect critical U.S. space systems against various threats at all levels of conflict. Sensor survivability efforts include development and demonstration of devices which can counter laser jamming and/or devices which can withstand levels of laser radiation sufficient to cause physical damage.

Due to FY 1987 Congressional funding reductions, award of two parallel concept definition contracts for the Satellite On-board Attack Reporting System (SOARS) was delayed until the second quarter of FY 1987.

In FY 1988, testing of CERR materials will continue and the technology will be transitioned to the appropriate satellite program offices for use. Development of SOARS will continue with the detailed design of a prototype flight system. In FY 1989, SOARS prototype fabrication and qualification testing will begin. On-orbit testing of SOARS is planned for FY 1990/1991.

C. (U) Project: 2613, Ground Station/Link Survivability. This project develops concepts and demonstrates the technical feasibility of prototype hardware and new operational procedures to counter the threat against space system tracking, telemetry, and control (TT&C) and mission data links, operations centers, and ground stations. It develops both prototype and initial operational capability systems. This project provides proven survivability improvements to support validated Statements of Need and Mission Element Need Statements (SONS/MENS) and attendant acquisition programs oriented toward space system ground stations and data links. No efforts were performed in FY 1987 due to funding limitations. In FY 1988, several efforts to improve link survivability will be initiated. These include developing a jam monitoring and warning unit for use at ground sites and completing a coordinated program to upgrade commercial communications into secure, anti-jam links for use by the military in times of conflict. The FY 1989 efforts will continue with these link survivability improvements.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604211F
DOD Mission Area: 452 - Aerial Targets

Title: Advanced Aerial Targets Development
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to . . Completion | Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 10,671 | 9,848 | 3,711 | Continuing | N/A |
| 2459 | Target Payload Systems | 1,171 | 4,048 | 3,711 | Continuing | N/A |
| 3165 | QF-106 Full-Scale Aerial Target Systems | 9,500 | 5,800 | 0 | 0 | 21,800 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Aerial Targets are essential to insure air-to-air weapons effectiveness and mission proficiency of our tactical air crews against enemy aircraft. The overall objective is to improve air-to-air weapon system accuracy and reliability by developing aerial target systems for Air Force weapon system test and evaluation. In addition, full-scale targets (QF-100 and QF-106) are used to support US Army air defense test and evaluation programs such as the Divisional Air Defense follow-on program, Stinger, Patriot, and improved Hawk. The targets being developed provide a cost effective mix of full-scale and subscale aerial targets. Full-scale targets provide a fully representative target with realistic maneuvering performance, radar cross section, and afterburning engine infrared signature. Subscale targets are a lower cost supplement used when threat simulation fidelity is not as critical. The Target Payload Systems task will increase target effectiveness by improving subsystems for missile scoring and by developing subsystems which will provide target representative radar and infrared signatures. QF-106 development will provide a follow-on to the QF-100 full-scale targets which will complete procurement in FY 1987.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 10,777 | 9,886 | 3,714 | Continuing | N/A |
| Missile Procurement | 0 | 0 | 24,800 | 70,100 | 94,900 |

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Project 3165, QF-106 | | | | | |
| Funds | 0 | 0 | 24,179 | 70,721 | 94,900 |
| Quantities | 0 | 0 | 48 | 144 | 192 |

5. (U) RELATED ACTIVITIES: The three Services actively cooperate in the development of various target systems and subsystems. Coordination is insured by the Joint Logistics Commanders through an active Joint Technical Coordinating Group for Aerial Targets. Formal coordination through the Department of Defense Armament/Munitions Requirements,

Acquisition, and Development Committee prevents duplication. Targets are procured under PE 0305116F, Aerial Targets.

6. (U) WORK PERFORMED BY: Honeywell Inc., Sperry Defense Systems Division, Albuquerque, NM (Project 3165, QF-106); Hayes International, Leeds, AL (Project 2459, Target Payload Systems - APC-4); Sverdrup Technolgy Inc, Tullahoma, TN, (Project 2459, Target Payload Systems - Afterburner Simulator); and Northrup, Chicago, IL (Project 2459, Target Payload Systems - ECM).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2459 - Target Payload Systems:

A. (U) Full scale and subscale targets require payload subsystems for missile and bullet scoring, radar and infrared signature augmentation, and electronic and infrared countermeasures. Current scoring systems provide only miss distance information. Systems are under development to provide not only miss distance, but also missile path past the target and missile position and attitude relative to the target at fuzing. Radar signature augmentation provides radar signatures for subscale targets that are representative of threat aircraft. Infrared signature augmentation on subscale targets provide a signature representative of threat military jet engines; however, these do not simulate the signature of an afterburning engine. Electronic and infrared countermeasures include systems such as chaff and flare dispensers.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In FY 1987, development improvements of the APC-4 continued. Improvements to be incorporated in the MQM-107D were flight tested on the MQM-107B (MQM-107D not available until FY 1988). Qualitative operational test and evaluation (QOT&E) of the APC-4 on the MQM-107B continued with emphasis on specific missile tracking performance. Pyrophoric afterburner simulator pods were fabricated. Integration, design and preliminary testing of a M130 flare/chaff dispenser for the MQM-107B were accomplished. Infrared imagery measurements of surrogate threat aircraft were completed. A contract for electronic countermeasures (ECM) on subscale and full-scale targets was awarded in Oct 1986. User requirements for the Missile End-Game Scorer (MEGS) were refined.

(2) (U) FY 1988 Program: In FY 1988, QOT&E of the APC-4 infrared plume generator pod on the MQM-107B will be completed and Development test and evaluation (DT&E)/QOT&E of the APC-4 on the MQM-107D will begin. A contract to integrate the APC-4 into the MQM-107E will be awarded. Efforts to develop an afterburner plume generator using pyrophoric materials were discarded due to the unsafe characteristics of this material. Development, integration and testing of target ECM and the M130 flare/chaff dispenser will continue. A Request for Proposals (RFP) for MEGS full scale development (FSD) will be released.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Efforts in FY 1989 will consist of initiation of FSD of MEGS, a vector scoring system to replace the current scalar scoring system on both subscale and full scale targets. A competitive contract for MEGS will be awarded in Nov 88. QOT&E of the APC-4 on the MQM-107D will be completed as will testing on the QF-106. Testing on the MQM-107E, the next subscale target, will be initiated.

8. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604227F
DOD Mission Area: 430 - Non-System Training Devices

Title: Flight Simulator Development
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 92,783 | 56,778 | 72,800 | Continuing | N/A |
| 2325 | Simulator Development Activities | 8,400 | 5,278 | 3,386 | Continuing | N/A |
| 2632 | B-52 Offensive Avionics Station | 3,640 | 0 | 0 | 0 | 30,590 |
| 2687 | EF-111A Operational Flight Trainer | 127 | 0 | 0 | 0 | 12,732 |
| 2769 | Simulator Update Development | 5,643 | 6,500 | 3,726 | Continuing | N/A |
| 2851 | Standard Department of Defense (DOD) Simulator Data Base/Common Transformation Program | 2,947 | 2,405 | 1,207 | 8,200 | 16,370 |
| 2854/5 | C-5/C-141 Aerial Refueling Part Task Trainer | 93 | 0 | 0 | 0 | 11,255 |
| 2901 | B-1B Weapon System Trainer | 13,281 | 5,000 | 5,000 | 0 | 105,886 |
| 2903 | F-15/F-16 Simulator for Air-to-Air Combat | 1,619 | 0 | 0 | 0 | 7,371 |
| 2968 | Modular Simulator Design | 2,416 | 2,000 | 2,025 | 1,524 | 8,886 |
| 2997 | GBU-15 Part Task Trainer | 7,188 | 1,350 | 0 | 0 | 16,874 |
| 2998 | LANTIRN Simulator | 15,368 | 9,214 | 3,051 | 600 | 35,821 |
| 2999 | LANTIRN Part Task Trainer | 6,472 | 5,917 | 486 | 0 | 13,108 |
| 3000 | KC-135 Operational Flight Trainer | 9,344 | 3,586 | 900 | 294 | 26,978 |

Program Element: 0604227F
DOD Mission Area: 430 - Non-System Training Devices

Title: Flight Simulator Development
Budget Activity: 6 - Defense-Wide Mission Support

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| 3105 | F-15 Weapon System Trainer | 7,532 | 196 | 6,233 | 0 | 40,432 |
| 3135 | Advanced Training System | 2,588 | 2,154 | 3,432 | 35,398 | 45,046 |
| 3143 | Advanced Tactical Fighter (ATF) | 0 | 1,900 | 4,849 | 233,551 | 240,300 |
| 3282 | C-17 Aircrew Training System | 6,125 | 11,278 | 38,505 | 44;976 | 100,884 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a continuing program element for the development of aircrew flight simulator techniques and training devices. The objectives are to adapt flight simulation technology developed in the laboratories and industry to satisfy current and future training requirements, and to develop prototype training devices.

3. (U) COMPARISON WITH FY 1988/1989 Descriptive Summary: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 96,412 | 61,701 | 64,467 | Continuing | N/A |

EXPLANATION: (U) FY 1987 reduction of $3.6 million due to internal Air Force Adjustments. FY 1988 reduction of $4.9 million due to Congressional action and internal Air Force adjustments. FY 1989 additional funding required to incorporate aircraft changes in the training systems for the F-15E and B-1B.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| Aircraft Procurement: | | | | | |
|---|---|---|---|---|---|
| 2769 Funds (PE 0804741F) | 6,000 | 1,500 | 0 | 0 | 15,500 |
| Quantities | 4 | 3 | 0 | 0 | 11 |
| 2901 Funds (PE 0101126F) | 4,900 | 1,600 | 4,400 | 0 | 162,200 |
| Quantities | 0 | 0 | 0 | 0 | 12 |
| 2997 Funds (PE 0207131F) | 0 | 2,500 | 0 | 0 | 2,500 |
| Quantities | 0 | 2 | 0 | 0 | 2 |
| 2997 Funds (PE 0207252F) | 0 | 2,100 | 0 | 0 | 2,100 |
| Quantities | 0 | 1 | 0 | 0 | 1 |

Program Element: 0604227F — Title: Flight Simulator Development
DOD Mission Area: 430 - Non-System Training Devices — Budget Activity: 6 - Defense-Wide Mission Support

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| 3000 | Funds (PE 0101142F) | 50,100 | 3,900 | 0 | 5,600 | 59,600 |
| | Quantities | 15 | 1 | 0 | 2 | 18 |
| 3105 | Funds (PE 0207130F) | 75,100 | 42,200 | 74,300 | 69,900 | 316,100 |
| | Quantities | 2 | 0 | 2 | 1 | 6 |

5. (U) RELATED ACTIVITIES: Technologies from inter- and intraservice coordination of science and technology and the Air Force Human Resources Laboratory (AFHRL) science and technology programs provide support to this program element. Specific programs include: PE 0602205F, Personnel Training and Simulation, and PE 0603277F, Personnel and Training Simulation Technology.

6. (U) WORK PERFORMED BY: The Deputy for Training Systems, Wright-Patterson AFB OH, is responsible for the majority of work performed in this element. Ogden Air Logistics Center manages the modification to the F-4E/G and KC-135 simulators. AFHRL is responsible for the F-15/F-16 Simulator for Air-to-Air Combat (SAAC). The following is a list of the contractors and their contract efforts: Singer-Link, Binghamton NY (F-4E/G computer replacement, F-15/F-16 SAAC upgrade, C-135 modifications, Low Altitude Navigation and Targeting Infrared System for Night, B-52 Offensive Avionics Station and the C-130 Aircrew Training System); AAI Corp, Baltimore MD (EF-111A Operational Flight Trainer and Simulator for Electronic Warfare Trainer modification); Reflectone Corp, Tampa FL (C-5A/C-141B Aerial Refueling Part Task Trainer); Boeing Military Airplane Co, Huntsville AL (B-1B Simulator System and KC-135 Operational flight trainer); and Goodyear Aerospace Corp, Akron, OH (F-15E Weapon System Trainer). Fourteen other contractors are performing work valued at roughly $100 million in FY 1988 and FY 1989 combined.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2325, Simulator Development Activities. This project funds engineering development of training system technology techniques and preproduction or first article training devices to satisfy current and future training requirements. The project also addresses identified deficiencies in training capabilities, improves concurrency between aircraft and flight simulators, and reduces life cycle costs. Approximately 40 unique tasks are being accomplished within this project. They include radar sensor data base development; evaluation of the Synthetic Aperture Radar simulation application; completion of engineering development and evaluation of a helmet-mounted visual display; three promising approaches to satisfy the requirement for a full field-of-view visual system; development of an authoring system for Computer-based Instructional Systems; and development of a generic trainer and other similar small part task trainers. In FY 1987, we continued development/evaluation of a user friendly authoring language for Computer-Based Instructional Systems (CBI), a visual sensor commonality study, evaluation of state-of-the-art visual display systems for engineering acquisition specifications; and evaluation of an embedded training concept for future programs. Planned in FY 1988 are assessments of artificial intelligence for Instructor Operator Station and CBI,

continued development of multi-cockpit Instructor Operator Station (IOS) and initiation of development of a multi-station IOS, as well as continued evaluation of infrared and electronic combat simulation. We also plan to initiate development of an embedded training prototype program for training/cost trade-off analysis. In FY 1989, we will continue artificial intelligence research for an IOS in support of complex tactical missions and continue development and interpretation of a multi-cockpit IOS. We will also: continue development of an embedded training prototype maintainability and reliability data base, complete full field-of-view visual system development, and address a tactical simulator prototype for air-to-air/air-to-ground combat environment, and initiate development of a low cost image generator for sensor simulation. Work tasks within this project are based on Category II through IV cost estimates. Complies with OSD guidelines as follows: Provides data that will be used as generic building blocks in the development of new training devices; develops sensor simulation for generic infrared and visual systems; is the only project that addresses requirements and test and specification development with an extensive framework developed for front-end analysis. The emphasis is on generic and joint service development for use on all simulator programs to reduce acquisition and life cycle costs, reduce acquisition time, and improve reliability, maintainability and availability.

B. (U) Project: 2769, Simulator Update Development. This project updates training systems to maintain and improve their supportability and effectiveness. It includes development of a C-130 Aircrew Training System (ATS) and replacement of the logistically unsupportable terrain model board visual system on the Undergraduate Pilot Trainer-Instrument Flight Simulator (UPT-IFS), with a computer-generated image visual system. In FY 1987, we completed fabrication and testing of the T-5 electronic warfare simulator upgrade, conducted design reviews and completed prototype fabrication, and began in-plant testing for the computer replacement for the F-4 Operational Flight Trainer (OFT), and exercised production options for the UPT-IFS visual system. In FY 1988, we will procure three visual systems to complete the UPT-IFS replacement. The C-130 ATS develops courseware, scheduling, management, and evaluation tools necessary to integrate current facilities, training devices, and operational equipment into a state-of-the-art training system. The system includes proficiency-based syllabus development; automated daily scheduling of students, instructor pilots, aircraft and simulators; automated record keeping and evaluation; computer-based instruction; and structuring of the program to allow generically based research and development studies. The contractor guarantees fully qualified students in all aircrew positions at the formal school. The contract was awarded to the Singer Co., Link Division, on 9 Apr 1987. In FY 1988, the contractor will begin phasing in the ATS to replace Air Force simulator maintenance and instructor personnel. In FY 1989, development will be completed and the prototype training system fielded. In FY 1990, the C-130 ATS will be fully operational. Complies with OSD guidelines as follows: addresses the development of an Aircrew Training System for C-130 aircrews using best commercial practices.

C. (U) Project: 2851, Standard DOD Simulator Data Base/Common Transformation Program. The Joint Logistics Commanders initiated this project to develop a standard DOD digital data base that uses Defense Mapping Agency data for displays for aircrew training (e.g., visual, radar, infrared). The transformed data base would be provided as Government Furnished Equipment to simulator manufacturers, eliminating the cost associated with the current approach of developing a unique system for each simulator program that requires sensor simulation. In FY 1985, the first and second tasks (requirements evaluation and cost benefit analysis) of this six-task project were completed. Task 3 (a transformation efficiency study) and Task 4 (data base requirements definition which defines both data base content and the data base generation concept) were also completed. Task 5 (program development) began in FY 1987 with contract award to the

Planning Research Corporation of McLean VA. Development will be completed FY 1989. Test, evaluation and implementation of this program occurs in FY 1988 and FY 1989. Complies with OSD guidelines by developing standard data base and transformation programs for sensor simulation on all training devices to reduce acquisition and life cycle costs.

D. (U) Project: 2901, B-1B Simulator System. The Strategic Air Command requires training devices for all B-1B crew members. Training tasks include mission rehearsal for takeoff and landing, navigation, air refueling, threat analysis/countermeasures, low level penetration, weapons delivery, and emergency procedures. Emphasis is placed on integrated crew training and other tasks that cannot be accomplished in the aircraft including safety-of-flight restricted emergency procedures, and Emergency War Order rehearsal. In Phase I, two contractors competed through preliminary design review; Boeing Military Airplane Co. was selected to complete the acquisition in Phase II. Devices procured include five Weapon System Trainers (WSTs) simulating all four crew positions, two stand-alone Mission Trainers (MTs), simulating the offensive and defensive positions, and six Cockpit Procedures Trainers (CPTs), simulating all four crew positions. The FY 1986 program completed initial development, fabrication, and hardware/software integration of the prototype WST, and in-plant test commenced. The production option for Lot II (two WSTs and two MTs) was also exercised. Five CPTs were delivered to the field in FY 1987. The prototype WST will be delivered in March 1988 followed by delivery of production WST units 1, 2, and 3 also in FY 1988. Mission Trainers 1 and 2 will be delivered in FY 1989 along with production unit 4. In FY 1989, we will also award a contract to incorporate aircraft driven changes in the training system in order to keep the aircraft and simulator in the same configuration. OSD guidelines do not apply, project initiated prior to FY 1986.

E. (U) Project: 2968, Modular Simulator Design. A strong requirement exists to reduce life cycle cost, reduce development lead time, improve our ability to deliver simulators to the field concurrently with the aircraft (to keep the configuration of the simulator the same as the aircraft and to update simulators as new and different technologies are needed for training), and to increase the competitive contractor base. Phase 1 was a Request for Information from the simulator industry to assess, from an industry perspective, the feasibility of modular simulators, the advantages, disadvantages, cost, and potential impact on technology. The second phase was a competitive effort with Logicon and the Boeing Co. to identify the tools necessary to implement modularity and to develop a suggested specification, statement of work, and implementing strategy. The evaluation of Phase II was completed in FY 1985. This was a tri-service effort to analyze the contractors' approaches, and then identify an approach to Phase III given the technical, cost, and supportability considerations identified in the first two phases. In FY 1986, the Request for Proposal was developed and released for Phase III; the contract was awarded to the Boeing Military Airplane Company on 12 March 1987. In FY 1988, basic design and definition will be completed (in time to support the Advanced Tactical Fighter Training System). The modular design and definition will lay the foundation for the demonstration and validation phase in FY 1988 through FY 1990. Complies with OSD guidelines by reducing acquisition and life cycle costs by development of standard interfaces between simulator pieces using best commercial practices.

F. (U) Project 2998, Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) Simulator. The LANTIRN simulator, when integrated with an Operational Flight Trainer (OFT), will provide the capability required to fully train pilots in LANTIRN usage. The Tactical Air Forces require a safe, efficient means of training the LANTIRN mission in a high threat, night, adverse weather, heavily task loaded environment simulating combat. A development contract was awarded to Singer-Link Co., in June 1986. Initial design was completed in FY 1987 as well as hardware subsystems fabrication, software development, and the exercise of production options for four F-16 LANTIRN simulators. FY 1988 will mark the beginning of integration of hardware and software, followed by contractor in-plant tests and government qualification tests. Integration of the LANTIRN simulator with the F-16 OFT will also start in FY 1988. In FY 1989, integration of the LANTIRN with the F-16 OFT will be completed and delivery of the first unit is scheduled for the first quarter of FY 1990. This will be one of the first concurrent deliveries of a training system with the parent weapon system. OSD guidelines do not apply, project initiated prior to FY 1986.

G. (U) Project: 2999, LANTIRN Part Task Trainer (PTT). The complexity of the LANTIRN system and inherent danger of operating close to the ground in the night and adverse weather requires initial training that enhances safety and speeds understanding of system operation. LANTIRN PTTs will effectively train pilots in LANTIRN (F-16, F-15E) switchology, modes of operation, and F-15E avionics. These training devices will provide an accurate representation of the aircraft cockpit, including all functional controls and switch responses, to provide aircrews with familiarization training that will provide the lead in training for the more complex and dynamic LANTIRN simulation in Project 2998. Source selection activities commenced in FY 1986 and culminated with contract award to Educational Computer Corporation on 14 November 1986. The initial development will be for the F-15E PTT. In FY 1987 we exercised the option to start the F-16 PTT development. Production options will be exercised in FY 1988 with deliveries scheduled in FY 1989. OSD guidelines do not apply; project initiated prior to FY 1986.

H. (U) Project: 3000, KC-135 Operational Flight Trainer (OFT). To train its KC-135 crews, the Strategic Air Command (SAC) needs to refurbish and update their outdated MB-26 procedures trainers. The devices are expensive to maintain, almost always out of commission, and unrealistic. In July 1981, the Aircraft Safety and Operations Review Board, after investigating several KC-135 accidents, highlighted the need for new KC-135 simulators, particularly for engine-out and emergency procedures training. The KC-135 Operational Flight Trainer will simulate the pilot and copilot stations and incorporate an on-board instructor's station as well as a computer image-generated visual system for takeoff, landing and engine-out training. The OFT will also accurately simulate the total aircraft flight envelope and will meet SAC requirements for annual instrument evaluations. A total of 18 trainers will be optioned for upgrade to the KC-135 OFT configuration (approximately eight in the KC-135A configuration and ten in the KC-135R configuration). The contract was awarded to the Boeing Military Airplane Co. on 20 Mar 1986. In FY 1986, the contractor began initial design and development of the KC-135R flight station, aerodynamics, student stations, instructor station and computational system. In FY 1987, flight data was collected, the initial design was completed, and hardware and software integration began. Options for development of the KC-135A configuration and five production units were exercised in March 1987. Starting in FY 1988, contractor in-plant testing and government qualification testing will be conducted, followed by shipment to the field of the first unit for final acceptance testing. Additionally in FY 1988 through FY 1990, production options for the remaining devices will be exercised. This is a Category I cost estimate. OSD guidelines do not apply--project initiated prior to FY 1986.

I. (U) Project: 3105, F-15E Weapon System Trainer (WST). A fighter that conducts interdiction bombing as well as air-to-air missions must be supported by an aircrew training system that trains both missions. The F-15E WST will train both pilot and weapon system officers and will include Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) simulation. The trainers will be a modification to the F-15 OFT already being manufactured by Goodyear Aerospace Corp. A total of six WSTs will be procured. In FY 1985, the development contract for the WST was awarded and the Request for Proposal for production of the first WST with priced options for units 2 and 3 was released. In FY 1987, the basic design was completed as well as fabrication of cabling assemblies, and award of the production contract. Detailed design of the flight station, instructor station, computational system, and LANTIRN simulation continued. In addition, hardware/software integration and contractor in-plant tests were completed and the production option for unit 2 was exercised. In FY 1988, combined government/contractor testing will be accomplished and the first trainer will be delivered in the fourth quarter. In FY 1989, The production option for unit 3 will be exercised as well as contract award to incorporate aircraft driven changes in the training system. OSD guidelines do not apply--project initiated prior to FY 1986.

J. (U) Project: 3135, Advanced Training System (ATS). Changes to the Air Force training environment have resulted in an increased training workload at Air Training Command (ATC) Technical Training Centers. More complex equipment has increased student instructional needs. As training requirements have increased, the number of experienced instructors has decreased. ATC is therefore increasingly unable to conduct remedial or individualized instruction. This results in a greater number of personnel in the training pipeline, increased attrition, lower achievement, and ultimately reduced operational readiness. The ATS will provide information presentation, demonstration, drill and practice, evaluation, feedback, and remedial training. Its main goals are to free instructors for remedial instruction in complex tasks, promote efficient training methods, and provide rapid course updating. The ATS program responds to the Defense Science Board 1982 Summer Study on Technical Training which recommended improvements to our training approach. The ATS is a three-phased program to provide a computer-based training system to alleviate this deficiency. Phase I was a contracted concept exploration and validation effort completed in September 1984 and it was funded and managed by Air Training Command (ATC). Phase II develops the prototype system for two courses at one ATC Technical Training Center. Phase III acquires systems for four other centers. In FY 1985, the system specification was drafted for Phase II, and the development site and courses were selected. In FY 1988, the development contract will be awarded and the initial computer hardware selection will occur. In FY 1988-1989, we will complete development and exercise production contract options. OSD guidelines do not apply--project initiated prior to FY 1986.

K. (U) Project: 3143, Advanced Tactical Fighter (ATF) Training System. The Tactical Air Forces require an ATF Training System to meet Manpower, Personnel and Training needs to support operations personnel assigned to the weapon system. Required training tasks include initial, continuation, upgrade, on the job training and mission qualification levels which emphasize new job requirements; Front-End Analysis (FEA) process will define all training requirements and integrate these findings into an ATF Total Training System which will optimize program accuracy, timeliness, currency and economy. The FEA is broken down into two activities: In Step 1, the prime weapon system contractors were required to accomplish an FEA concurrently with their weapon system design task. That process will result in the description of a total training system to include impact of new technologies, and a functional description of all system elements.

Step 2 will require an independent Front End Analysis (FEA) specialist to integrate all of the individual contractor data, analyze the user training requirements and present to the Air Force recommendations and alternatives for implementing, supporting and operating a total training system. In 1985, the Advanced Tactical Fighter (ATF) Demonstration/Validation Request for Proposal was amended to include the accomplishment of an FEA by each of the winning contractors as an integral element of their design process. The amendment included technical, management and supportability perspectives. In FY 1986, the ATF Demonstration/Validation Source Selection was started and was completed through contract award in the first quarter of FY 1987. In late FY 1987, the midterm review of each ATF contractor was accomplished. The FEA process required for the total ATF training system definition will be implemented through an independent FEA contractor. In late FY 1988 or early 1989, all ATF Training System FEA data will be analyzed and presented to the Air Force for implementation. Complies with OSD guidelines by early consideration of training requirements to effect concurrent delivery of a ground based training system in the most cost effective manner.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3282, C-17 Aircrew Training System (ATS)

A. (U) Project Description: This project is designed to meet the needs of the Military Airlift Command (MAC) and Air Reserve Forces in supplying initial and continuation training for C-17 crew members. Training will be totally contractor administered and supported, with MAC evaluating the final product--a fully qualified aircrew member. There will be a main facility for initial-through-instructor training, learning centers at four main operating bases for continuation training, and two sites for the training of Guard and Reserve personnel. Emphasis will be on integrated crew training and training tasks that cannot be accomplished in the aircraft, including those related to safety of flight, emergency procedures, and others for which a suitable flight training environment does not exist. The training system will be developed concurrently with the aircraft design effort, allowing a training system to be available at the formation of the first operational squadron. In September 1985, Douglas Aircraft began delivery of detailed task listings with semiannual updates until the end of the Full Scale Development contract. An eight-month front end analysis effort by Illinois Institute of Technology Research Institute (IITRI) is designed to provide a preliminary aircrew master task listing. An aircrew evaluation standard was completed in FY 1986. Acquisition of the actual C-17 Aircrew Training System has been divided into two phases to sustain competition as long as possible. Phase I was a full and open competition to determine which company has the best capability to field and support an ATS. Three contractors were chosen to provide detailed functional designs of their total systems. Phase II will begin in FY 1989 after the selection of one of these contractors to complete the final design, development, testing, deployment, activation, and operation and support of the training system. Complies with OSD guidelines through early consideration of training needs with the parent weapon system, and development of a training system using best commercial practices.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Contract award for Phase I occurred in July 1987. Contracts were awarded to: the Singer Co., Link Division, United Airlines Services Corporation, and McDonnell Douglas.

(2) (U) FY 1988 Program: Downselect from three contractors to one to develop and produce the training system consisting of courseware and ground based instruction, full logistics support, total system management and operation, guaranteeing student throughput and instruction quality. Number and types of devices are not yet final, but estimates were arrived at by comparing the anticipated C-17 student throughput with that on the C-5 Aircrew Training System (ATS) contract. The estimate was formally accomplished in June 1986 and is currently being reviewed. Because data does not exist for the cost of a trained student (although the student is the final product), the estimate assumed that a reasonable and reliable cost estimate for an ATS could be arrived at by predicting the types and numbers of devices to be used by the contractor. Because of this approach, it is a Category IV cost estimate.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The effort in 1988 to develop and produce a training system will continue through preliminary design, critical design and the beginning of hardware/software integration. Configuration control procedures, update management, course syllabus, and overall system management will be defined.

(4) (U) Program to Completion: The development portion of the C-17 ATS will continue with deployment and the first site activation in June 1991. Annual production options will be provided to activate and support successive ATS sites. The final site will be activated in FY 1999 and the contract will terminate in FY 2003.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) (U) Draft Request for Proposal Release | August 1986 |
| (2) (U) RFP Release | December 1986 |
| (3) (U) Proposal Submittal | January 1987 |
| (4) (U) Contract Award | July 1987 |
| (5) (U) Receive Downselect Proposals | April 1988 |
| (6) (U) Downselect Decision | October-December 1988 |
| (7) (U) ATS Ready For Training--First Main Operating Base | June 1991 |

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

**Program Element:** 0604609F
**DOD Mission Area:** 475 - Central Supply Maintenance
**Title:** R&M Technology Insertion Program (RAMTIP)
**Budget Activity:** 6 - Defense-Wide Mission Support

1. (U) **RDT&E RESOURCES (PROJECT LISTING):** ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 13,821 | 14,942 | 20,760 | Continuing | N/A |

2. (U) **BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** The Air Force recently implemented an action plan called Reliability and Maintainability (R&M) 2000. A key element in this multi-faceted effort to institutionalize R&M is to consolidate various Air Force R&M initiatives into a cohesive program. This action will provide essential improvements in management, control, and coordination of the Air Force's R&M program. RAMTIP represents one aspect of this effort. Its purpose is to accelerate the transition of new R&M technologies into fielded, in-production, and future systems. The leverage/payoffs to be gained from this effort are: greater combat capability; increased survivability of the combat support structure, more efficient use of mobility and manpower assets, and lower operational and support costs.

3. (U) **COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY:** ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 13,563 | 20,365 | 26,279 | Continuing | N/A |

**EXPLANATION:** The reduction in the FY 1988 funding is the result of Congressional action. The reduction in the FY 1989 funding is the result of lower than anticipated growth in the Air Force budget. These reductions slow the rate of R&M technology insertion and result in lost opportunities to increase combat capability while decreasing support costs. Specifically, the SEEK IGLOO VHSIC insertion effort, discussed in paragraph 8.B.(4), has been delayed 1 year.

4. (U) **OTHER APPROPRIATION FUNDS:** Not Applicable.

5. (U) **RELATED ACTIVITIES**: The projects in this program currently interface with: PE 0604706F - Life Support Systems; PE 0604231F - C-17 Program; PE 0604226F - B-1B Program; PE 0207130F - F-15 Program; PE 0603256F - CV-22A; and PE 0604312F - Intercontinental Ballistic Missile Modernization. RAMTIP projects involve full scale development and prototyping efforts for high-leverage technologies that have not been included in the budgets of the above programs because of timing or risk concerns. Once these R&M technologies are successfully demonstrated, implementation funds are programmed as part of the baseline budgets of the above programs. RAMTIP plays a complementary role with the Aircraft Engine Component Improvement Program (CIP) in PE 0604268F and the Productivity, Reliability, Availability, and Maintainability (PRAM) program in PE 0708026F. The CIP is concerned with R&M improvement in operational aircraft engines while PRAM solves immediate R&M problems with off-the-shelf technology. RAMTIP's charter specifically precludes projects that are covered by the engine CIP and PRAM program.

6. (U) **WORK PERFORMED BY**: Overall management of this effort will be accomplished by the Joint Technology Insertion Office, Wright-Patterson AFB, OH. Other involved organizations include: HQ USAF, Washington DC; Air Force Systems Command (AFSC), Andrews AFB, MD; AFSC Product Divisions; AFSC Labs; Air Force Logistics Command (AFLC), Wright-Patterson AFB, OH; and AFLC Air Logistics Centers (ALCs).

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:** Not Applicable

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1989:**

(U) Project: 0604609F, RAMTIP

A. (U) Project Description: Today, and for the foreseeable future, a combat capability shortfall exists, vis-a-vis the current and postulated Soviet threat. The introduction of new weapon systems will improve the situation, to some degree, but will only partially close the gap. To help overcome this shortfall, the Air Force must accelerate the transition of promising new technology into current, in-production and future weapons systems. Critical to this effort is RAMTIP.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 program continued work on the transition of three key reliability & maintainability (R&M) technologies.

(a) (U) The first of these efforts is the insertion of an On-Board Inert Gas Generating System (OBIGGS) into the C-17. OBIGGS performance will be established over a wide range of mission parameters so that data will be available not only for the C-17 but also for development of design criteria for the C-130, C-5, C-141 and other

airlift aircraft requiring inert fuel tanks. Benefits from this project include: elimination of the current liquid nitrogen (LN2) system and reduction of vulnerability due to ground based support facilities, equipment and personnel; and a $21 million reduction in operation and support (O&S) costs over the current LN2 inerting system.

(b) (U) The second project is the Advanced Rocket Nozzle Inspection System (ARNIS). This initiative transitions, from the lab to the manufacturing process, a nondestructive evaluation technique using low energy x-ray Computed Tomography for testing carbon-carbon rocket nozzles. The adaption of this technology will reduce costs by a factor of five and enhance production quality (100% reliable inspections) and productivity.

(c) (U) The third project is the B-1B Central Integrated Test System (CITS) Expert Parameter System (CEPS). This project applies artificial intelligence to analyze in-flight recorded system status data for the purpose of improving aircraft readiness. CEPS will accomplish this by reducing test time by 60%, "cannot-duplicate" by 30% and "retest-ok" by 30%. These reductions equate to increased combat capability and lower support costs (approximately $160 million) over the life of the B-1B.

(d) (U) In addition, the Air Force began the transition of some promising new technologies that will make, when fully applied, major improvements to the reliability and maintainability of Air Force weapon systems. The first of these efforts is the incorporation of Molecular Sieve Oxygen Generating System (MSOGS) into the F-15E fighter aircraft. From studies and operational experience it is known that MSOGS provides significant improvements over the current Liquid Oxygen (LOX) system. These improvements include: higher reliability - by a factor of 10; greater survivability - reliance on complex LOX infrastructure not needed; decreased mobility requirements - 3 to 5 pallets saved per deploying squadron; decreased manpower requirements - overseas, 10 manpower spaces saved/stateside, 3 manpower positions saved; decreased costs - cost/benefit analysis indicates that MSOGS costs less than the LOX (approximately $3.0 million saved per squadron - life-cycle).

(e) (U) Another high leverage initiative is the incorporation of new Klystron Power Amplifier technology into the E-3A. This new technology tube will dramatically improve the operational reliability (fivefold improvement over current power amplifier) and availability of the E-3A while reducing on-aircraft maintenance time by 70%. This effort will also reduce supportability costs and provide a suitable replacement for an item with an identified obsolescent source of repair.

(f) (U) A third new effort is the development of a microminiature Time Stress Measurement Device (TSMD). This is a device to measure and record selected environmental conditions on an electronic circuit board in order to identify environmental conditions at time of failure. This information can be used to reduce false removals, facilitate warranty claims, and improve preventive maintenance planning for any electronic equipment. Initial applications will be in the A-10 electronics suite.

(g) (U) Finally, the Air Force began transitioning the latest advances in electronic technology using Very High Speed Integrated Circuit (VHSIC) architecture project to facilitate VHSIC retrofit in fielded systems. This effort develops and demonstrates (in the F-16 Fire Control Radar) a VHSIC insertion "toolbox" concept consisting of VHSIC module starter kits, standard enclosures, and high reliability power supplies.

(2) (U) FY 1988 Planned Program: The FY 1988 program continues the seven FY 1987 projects, i.e., On-Board Inert Gas Generating System (OBIGGS), B-1B Central Integrated Test System (CITS) Expert Parameter System (CEPS), Advanced Rocket Nozzle Inspection System (ARNIS), F-15E Molecular Sieve Oxygen Generating System (MSOGS), E-3A Klystron Power Amplifier (KPA), Microminiature Time Stress Measurement Device (TSMD), and the F-16 VHSIC Insertion Toolbox (VIT). The Air Force also will start four new transition efforts.

(a) (U) These include development of boron/epoxy, graphite/epoxy, and kevlar/epoxy repair patches for metal surfaces. These repair patches have the advantage of arresting crack growth without the need for drilling new fastener holes for a doubler. This technology application offers great promise for improving the fatigue lives of the C-141 and C-130 while reducing depot repair times fivefold.

(b) (U) Another effort, on composites repair, demonstrates high-strain and post-buckled repair concepts and techniques for field and depot repair of the CV-22A aircraft. Maintenance cost avoidances are expected to exceed $28 million over a 20 year life of the system.

(c) (U) A third effort determines field and intermediate level repair techniques for bladed disks, called BLISKs, used in the Advanced Tactical Fighter engine. These repair techniques will reduce engine turnaround time, decrease spare inventory requirements, and increase sortie generation capability.

(d) (U) The last effort, ultrasonic nondestructive evaluation (NDE), develops a field usable device to detect cracks and debonds in the inner bores of small solid rocket motors. This capability would negate the need to periodically take assets off combat ready status for shipment to depots for X-Ray inspection.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Air Force will continue nine of the eleven 1988 transition efforts to include: C-17 On-board Inert Gas Generation System, Advanced Rocket Nozzle Inspection System, F-15E Molecular Sieve Oxygen Generating System, E-3A Klystron Power Amplifier, F-16 VHSIC Insertion Toolbox, microminiature Time Stress Measurement Device, BLISK repair, CV-22A composite repair, and ultrasonic nondestructive evaluation.

(a) (U) Two new-start transition efforts for FY 1989 include the incorporation of VHSIC technology into Alaskan minimally attended radars (SEEK IGLOO). The SEEK IGLOO signal processor, which currently fails every 12.5 days on average, would be upgraded to improve reliability and maintainability, as well as radar coverage, for detection of low-level air attack. This project will increase the time between failure from once every 3.5 days to once every 7 months and it will reduce on-site manpower requirements by 50%.

(b) (U) The other project, C-130 Electronic Cockpit, will replace 60 analog cockpit instruments in the C-130 with 5 thin plate, liquid crystal display panels. As a consequence, availability of the C-130 fleet is expected to increase 2% thereby increasing intratheater airlift capability by 230 tons per day.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604707F
DOD Mission Area: 420 - Global Military Environmental Support

Title: Weather Systems (Engineering Development)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 12,170 | 12,488 | 8,761 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element provides engineering development of weather systems that, when fielded, will eliminate critical shortfalls in weather support to Air Force and Army operations. The increasing emphasis on Air Force operations during night and bad weather makes the rapid and accurate determination of weather conditions of increasing importance. Requirements for improved weather support have expanded much faster than the capabilities to support them. This program provides several efforts to upgrade weather support to meet these requirements. Efforts include development of equipment to process, display, and disseminate weather data and forecasts to fixed-base and tactical weather stations; development of a Doppler weather radar; and development of the capability to support electro-optical weapon systems on the battlefield. The following efforts are included: (a) Through existing technology in minicomputers, displays, and communications equipment, the development and fielding of the Automated Weather Distribution System (AWDS) will partially automate Air Force weather stations around the world to significantly improve timeliness and accuracy of weather intelligence; (b) Development of the joint Department of Defense, Department of Commerce, and Department of Transportation Doppler weather radar called the Next Generation Weather Radar (NEXRAD) will, for the first time, allow direct measurement of winds within storm systems. Such capability is vital to forecasting tornadoes, damaging winds, and damaging hail. NEXRAD will dramatically increase our severe weather warning capability; (c) In the past, weather support to combat operations has emphasized those weather parameters sensible to man. Many current and developing electro-optical weapon systems are affected by weather in totally different ways than man, i.e., visibility for a human could be unlimited, yet an infrared sensor would not lock onto a target unless it can detect a target temperature different than its background. Conversely, infrared sensors work well at night when people can see nothing. This program provides engineering development of the Battlefield Weather Observation and Forecast System (BWOFS), a capability to measure critical weather elements in enemy territories and the capability of translating these data into meaningful support to electro-optical weapon systems.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 8,163 | 12,537 | 11,769 | Continuing | N/A |

EXPLANATION (U) Funds were added in FY 1987 to meet requirement for additional NEXRAD development. FY 1989 funding decreased to meet budgetary constraints; defers engineering development of the AWDS Automated Observation Subsystem from FY 1989 to FY 1993.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement (PE 0305111F): | | | | | |
| Next Generation Weather Radar (NEXRAD) | | | | | |
| Funds | 25,195 | 23,716 | 26,491 | 123,900 | 199,302 |
| Complete Radar Quantities | 5 | 6 | 7 | 26 | 44 |
| User Set Quantities | 3 | 15 | 22 | 63 | 103 |
| Automated Weather Distribution System (AWDS) - Executive Subsystem | | | | | |
| Funds | 0 | 16,600 | 31,965 | 101,600 | 150,165 |
| Fixed Base Quantities | 0 | 5 | 44 | 118 | 167 |
| Transportable Quantities | 0 | 0 | 0 | 20 | 20 |

5. (U) RELATED ACTIVITIES: PE 0603707F, Weather Systems (Advanced Development), accomplishes advanced development projects whose results support PE 0604707F. Funds for procurement of systems developed in PE 0604707F are included in PE 0305111F, Weather Services. The Next Generation Weather Radar (NEXRAD) is a joint Department of Commerce (DOC), Department of Defense (DOD) and Department of Transportation (DOT) program. Development costs are shared: DOC - 60%, DOD - 20%, DOT - 20%.

6. (U) WORK PERFORMED BY: Automated Weather Distribution System (AWDS) development is managed by Electronic Systems Division, Hanscom Air Force Base, MA. The prime contractor is the Canadian Commercial Corporation, Ottawa, Canada. MacDonald, Dettwiler & Associates, Ltd, Richmond, British Columbia, Canada is the prime subcontractor. Development of the NEXRAD is managed by the Joint System Program Office within the National Weather Service, National Oceanic and Atmospheric Administration, Department of Commerce. The NEXRAD contractor is Unisys Corporation, Detroit, MI.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 0604707F, Weather Systems (Engineering Development)

A. (U) Project Description: The increasing emphasis on Air Force operations during night and bad weather makes the rapid and accurate determination of weather conditions of increasing importance. This project funds development of equipment and techniques for a badly needed upgrade of Air Force Air Weather Service support. Such support will make weather intelligence a force multiplier on the battlefield and will provide improved resource

protection through greatly improved severe storm detection and warning. The following areas are addressed: (1) The Automated Weather Distribution System (AWDS) will automate most weather data handling tasks within each Air Weather Service weather station at major Air Force bases, some Army installations, and Air Force tactical facilities. It will replace 1950's technology equipment currently in use. AWDS will use a minicomputer to accelerate data handling, incorporate more efficient forecast preparation techniques, and speed dissemination of precise and up-to-date weather intelligence. Once observations, forecasts, and weather warnings become available, the system will display them to the forecasters and local users. A unique aspect of AWDS is its development through the Joint United States-Canada Production and Development Sharing Program. As such, the Canadian Government is funding half of the development contract. (2) The Next Generation Weather Radar (NEXRAD), a joint Departments of Defense/Commerce/Transportation development and procurement effort, will provide a greatly improved storm detection and warning capability. This radar will detect severe surface wind, hail, tornadoes and turbulence using Doppler techniques; automate thunderstorm tracking; accelerate severe thunderstorm identification; and improve warning accuracy and timeliness through use of interactive warning preparation techniques. It will double radar detection of severe thunderstorms, cut the severe thunderstorm warning false alarm rate from 75 percent to 25 percent and increase tornado touchdown warning time from an average of 0 minutes to 20 minutes. (3) The Battlefield Weather Observation and Forecast System (BWOFS) is beginning engineering development and continuing advanced development. The advanced development effort validates the forecasting techniques and provides operational weather units a rudimentary battlefield capability to support electro-optical weapons systems with slow, labor intensive techniques. The engineering development program develops the capability to collect critical weather data from behind enemy lines using the Unmanned Air Reconnaissance System and develops automated weather forecast techniques specifically tailored to the electro-optical weapons systems. This will vastly increase timeliness and accuracy of weather support to Air Force combat operations involving the employment of electro-optical weapon systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: AWDS: Software and hardware development and integration were completed. IOT&E of the fixed base and transportable prototypes was conducted. AWDS-Automated Observation Subsystem (AOS): Specifications for the integration of existing, digital weather sensors, e.g., wind, temperature and pressure, were determined. NEXRAD: The initial phase of IOT&E was completed. Source selection for the limited production contract began. BWOFS: Specifications for Tactical Decision Aid software for tactical command and control systems to provide weather forecasts tailored to specific weapons on the battlefield were completed.

(2) (U) FY 1988 Program: AWDS: Deficiency corrections (as identified in IOT&E) will be integrated into the system prior to awarding the production contract. Specifications for a preplanned, interoperable capability between AWDS and other command and control systems and a base-wide distribution capability for graphics displays will be prepared. AWDS-AOS: Specifications will be completed and limited participation in the Department of Commerce Automated Surface Observations System will begin. NEXRAD: Deficiency corrections (as identified in IOT&E) will be developed and integrated into the system. BWOFS: Tactical Decision Aid software for battlefield weapons will be developed and integrated into Tactical Air Force command and control systems. Specifications for the Unmanned Air Reconnaissance System weather sensor will be prepared.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Automated Weather Distribution System (AWDS): The Request for Proposals for the Full Scale Development of preplanned product improvements will be prepared. The initial improvements will include an interoperable capability between AWDS and other command and control systems and a base-wide distribution capability for graphics displays. AWDS-Automated Observation Subsystem (AOS): Automated Surface Observations System prototypes will be installed and tested to determine their ability to meet DOD requirements and compatibility with AWDS. Battlefield Weather Observation and Forecast System (BWOFS): Tactical Decision Aid (TDA) development will continue. Development Test and Evaluation of the automated TDA will be conducted on Tactical Air Force command and control systems. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of the cost estimate was completed in July 1987.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | NEXRAD Request for Proposal for Prototype Development | | October 1982 |
| (2) | (U) | AWDS Request for Proposal for Prototype Development | | February 1983 |
| (3) | (U) | NEXRAD Development Contract Award | | June 1983 |
| (4) | (U) | AWDS Development Contract Award | | March 1984 |
| (5) | (U) | NEXRAD Initial Operational Test and Evaluation Start | | August 1986 |
| (6) | (U) | AWDS Initial Operational Test and Evaluation Start | | June 1987 |
| (7) | (U) | Battlefield Weather Forecast System Development Start | | December 1987 |
| (8) | (U) | Battlefield Weather Observation System Development Start | | May 1989 |
| (9) | (U) | NEXRAD Initial Operation (for the Department of Defense) | | September 1989 |
| (10) | (U) | AWDS Initial Operation | *(July 1989) | January 1990 |
| (11) | (U) | AWDS Preplanned Product Improvements Development Start | *(May 1988) | April 1990 |
| (12) | (U) | Battlefield Weather Forecast System Initial Operation | | 4th Quarter FY 1991 |

* Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Change

(10) (U) Production contract award and subsequent equipment delivery delayed to incorporate corrections to IOT&E identified deficiencies in the production specification prior to release of the request for proposals.

(11) (U) Delayed to ensure follow-on work is based on the baseline configuration established after software deficiencies, identified during IOT&E, are corrected.

Program Element: 0604707F — Title: Weather Systems (Engineering Development)
DOD Mission Area: 420 - Global Military Environmental Support — Budget Activity: 6 - Defense-Wide Mission Support

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: AWDS Full Scale Development (FY 1984 - FY 1988) was accomplished through the Joint United States - Canada Production and Development Sharing Program. Through this program, the Canadian government funded half ($14 million) of the development contract. The prime contractor is Canadian Commercial Corporation, Ottawa, Canada. MacDonald, Dettwiler & Associates, Ltd, Richmond, British Columbia, Canada is the major subcontractor.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604735F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: Range Improvement
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 58,965 | 55,782 | 40,065 | Continuing | N/A |
| 2152 | Mission/Engineering Support | 4,700 | 3,000 | 4,698 | Continuing | N/A |
| 2286 | Tactical Air Forces Range Equipment | 6,092 | 15,866 | 6,600 | Continuing | N/A |
| 3320 | Strategic Air Command Range Equipment | 5,965 | 5,500 | 6,300 | Continuing | N/A |
| 3321 | Airborne Radar Electronic Counter-Countermeasures | 1,931 | 1,616 | 2,092 | Continuing | N/A |
| 6510 | Flight Test Threat Systems Simulators | 40,277 | 29,800 | 20,375 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Wartime experience has shown that a disproportionate number of combat losses occur during an aircrew's first ten combat missions. There is a continuing requirement to reduce those potential losses by more realistic weapon system testing, aircrew training and tactics development. The increasing cost of operating modern weapon systems also mandates that we attain the most effective use of our test and training resources. The Range Improvement Program contributes to the qualitative improvement of our combat forces by developing instrumentation and air defense threat simulator systems to increase the effectiveness of development and operational testing, training, and large scale exercises.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 59,562 | 69,560 | 46,603 | Continuing | N/A |
| Aircraft Procurement (PE 0207429F) | 7,656 | 21,000 | 17,000 | Continuing | N/A |
| Aircraft Procurement (PE 0101897F) | 0 | 0 | 5,000 | Continuing | N/A |
| Other Procurement (PE 0207429F) | 39,293 | 55,868 | 69,035 | Continuing | N/A |
| Other Procurement (PE 0101897F) | 94,244 | 95,314 | 121,468 | Continuing | N/A |

(U) EXPLANATION: The FY 1988 program adjustments are a result of a congressional reduction of $13.7 Million. FY 1989 adjustment reflects reprioritization of Air Force programs.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement (PE 0207429F): | | | | | |
| Funds | 7,656 | 20,813 | 16,883 | Continuing | N/A |
| Quantity | N/A | N/A | N/A | N/A | N/A |
| Aircraft Procurement (PE 0101897F): | | | | | |
| Funds | 0 | 0 | 4,586 | Continuing | N/A |
| Quantity | N/A | N/A | N/A | N/A | N/A |
| Other Procurement (PE 0207429F): | | | | | |
| Funds | 34,372 | 73,750 | 57,189 | Continuing | N/A |
| Quantity | N/A | N/A | N/A | N/A | N/A |
| Other Procurement (PE 0101897F): | | | | | |
| Funds | 94,244 | 91,614 | 68,481 | Continuing | N/A |
| Quantity | N/A | N/A | N/A | N/A | N/A |

5. (U) RELATED ACTIVITIES: Not Applicable.

6. (U) WORK PERFORMED BY: This program is managed by the Armament Division, Eglin AFB, FL. Major contractors include General Dynamics Corporation, Ft Worth, TX (AN/MST-T1A) - Multiple Threat Emitter System); Metric Corporation, Ft Walton Beach, FL (AN/MPQ-T3 - Multiple Threat Emitter); Martin-Marietta, Denver, CO (AN/MSR-T4 - Electronic Warfare Signal Analyzer); Cubic Corporation, San Diego, CA (Air Combat Maneuvering Instrumentation System); and American Electronics Laboratories, Lansdale, PA (AN/MLQ-T4 - Ground Jammer). There are 20 additional contractors and $48.5 million in additional contracts.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2152, Mission/Engineering Support. This project provides the basic operating funds, system software acquisition, and systems engineering support for the Range Improvement Program. Basic operating support includes temporary duty costs, equipment and supplies. System software acquisition provides research and development funds for project software development. Systems engineering support provides technical evaluations, documentation nd development tasks to improve the simulated operational threat environment, and the instrumentation and range support equipment. Most of this effort is currently being accomplished by a systems engineering and technical assistance (SETA)

contractor, VSE Corporation, Ft Walton Beach, FL. In FY 1987, the project continued to provide range and system safety analyses, computer support, cost estimating support, travel, training, supplies and basic operating capital for the program. The SETA contractor provided continuing engineering support, conducted studies, and performed assessments and analyses. The FY 1988 and FY 1989 effort will continue to provide the basic operating funds, system software acquisition and systems engineering support for the Range Improvement Program. The $1.7M increase in FY 89 is to fund studies for establishing an EC test capability at Utah Test and Training Range (UTTR).

B. (U) Project: 2286, Tactical Air Forces (TAF) Range Equipment. This project provides for the development and procurement of various electronic, telecommunications and instrumentation equipment and systems for the tactical operational test and training ranges worldwide. This equipment will enhance range capability by more realistically simulating the combat environment and providing more accurate data for training, testing and evaluation to enhance aircrew training and combat readiness. FY 1987 funds will be used to continue development of the Gulf Range MEGS system and ACMI enhancements. Work will begin on improvements to the Unmanned Threat Emitter System. Additionally, development work will begin on software development for a Homestead AFB, FL, ACMI system, a Laser Engagement System (LES) for a A-10 aircraft supporting US Army exercises at the National Training Center, Ft Irwin, CA, and software upgrades to the Red Flag Measurement and Debriefing System (RFMDS) located at the Nellis AFB, NV. FY 1988 funds will be used to continue development of the Homestead ACMI, to start development of the Crow Valley Measurement and Debriefing System (CVMDS) for the Pacific Air Command, and to continue the design effort for the LES and software upgrade for the RFMDS. FY 1989 funds will continue the development of ACMI enhancements and software upgrades to the RFMDS. Development will begin on the advanced threat training emitters. This is a continuing program.

C. (U) Project: 3321, Airborne Radar Electronic Counter-Countermeasures (ECCM). This project provides upgrades and improvements to the radar test facility at Tyndall AFB to provide a capability to support airborne radar/weapon system ECCM engineering design, development and test programs. FY 1987 funds will continue the development of an APG-70 radar (F-15) test bench. FY 1988 funding will complete this effort as well as begin development of an APG-68 radar (F-16) test bench. FY 1989 funding will continue the effort.

D. (U) Project: 3320, Strategic Air Command (SAC) Range Equipment. This project provides the same type of range equipment, instrumentation, training emitter systems, etc., for SAC training ranges as does project 2286 for the tactical forces. The primary effort supports the development of a new Strategic Training Route Complex (STRC) for strategic bomber crew training and the development of the emitter system equipment to be used on the STRC to create a more realistic combat environment. The STRC will be a system of interlocking, low-level navigation routes with scored bomb legs. The range will be equipped with simulated enemy threat air defense systems (i.e., air defense radars and ground jammers) with measurement systems signals analyzers) to record crew/aircraft performance for no-drop bomb scoring, mission debriefing and training feedback. The range will also provide equipment performance evaluation. The STRC Route Integration Instrumentation Systems (RIIS) will collect and transmit STRC range data via microwave, landlines, and/or satellite to a central facility, the Strategic Training Center, for processing, formatting, and display. FY 1987 funding continued STRC/RIIS development. Funds were also used to begin threat updates to the AN/MST-T1 family of training emitter systems. FY 1988 funds will continue STRC/RIIS development and threat updates to the AN/MST-T1 emitter systems, and initiate performance enhancements to the AN/MSR T4 threat receiver/analyzer system. FY 1989 funding

development efforts, AN/MST-T1A and AN/MSR-T4 improvements as well as begin STRC initial operational test and evaluation planning.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 6510, Flight Test Simulators

A. (U) Project Description: This project funds the development of test quality simulators of the advanced Soviet air defense radar equipment. The simulators will be used in flight testing our new aircraft radars and avionics system's electronic warfare capability. This project also funds the simulator modifications necessary to maintain existing simulators to the current intelligence baseline. This project fills a continuing and expanding need to flight test and evaluate new, and newly modified, electronic combat (EC) equipment prior to production. To be effective, this testing must be conducted in an environment which accurately simulates the EC environment to include enemy threat radar simulators. In the past, the adaptability of airborne electronic countermeasure (ECM) systems was quite limited; however, new radar warning receiver signal processing technology and techniques and smart jamming systems are highly adaptive and allow ECM system flexibility. It is extremely difficult to construct a creditable test for such ECM equipment without a large number of different instrumented threat systems to cover the entire threat spectrum.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: FY 1987 continued development work on the [ ] radar simulator and Flycatcher radar enhancements. Full scale development continued on the [ ] threat simulator target tracking radar, target acquisition radar, and missile seeker. Contract definitization will be completed for a second [ ] threat system. Work continued on the development of the [ ] threat radar simulator.

(2) FY 1988 Program: FY 1988 funds will continue development work on the [ ] simulators. Simulator modifications will continue. Development will begin on the [ ] threat simulator.

(3) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funds will continue development work on the [ ] threat simulators. Existing simulators wil continue to be modified to incorporate the latest intelligence information.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604747F
DOD Mission Area: 454 - Other Test & Evaluation Support

Title: Electromagnetic Radiation (EMR) Test Facilities
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands):

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 5,399 | 5,919 | 5,233 | Continuing | N/A |
| 1209 | Nuclear Effects Simulation Test Facilities | 4,319 | 4,735 | 4,186 | Continuing | N/A |
| 2064 | HAVE NOTE | 1,080 | 1,184 | 1,047 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Nuclear weapon detonations generate electromagnetic pulses (EMP) which can damage electronic components. Nonnuclear electromagnetic emissions such as jamming may also cause component damage. The equipment malfunctions resulting from these electromagnetic environments can cause a significant reduction in weapon system effectiveness. This program element funds the operation, maintenance, and improvement of test facilities used by weapon system program offices to determine the ability of their systems to operate in nuclear (Project 1209) and non-nuclear (Project 2064) electromagnetic environments. Users of these facilities pay the actual costs of their specific tests. Under Project 2064, hardness criteria for non-nuclear electromagnetic effects are also developed for incorporation by users into aerospace weapon system design specifications and standards.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands):

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 5,496 | 5,942 | 6,238 | Continuing | N/A |

EXPLANATION: (U) The reductions reflect revised fiscal guidance and redirection of funds to higher priority programs. The impact on Project 1209 is cancellation of efforts to redesign electromagnetic pulse (EMP) simulators to conform to the new DOD-STD-2169, High Altitude EMP Environment, the cancellation of simulator reliability and maintainability upgrades, and the reduction of maintenance and spares provisioning for the new data acquisition system currently being acquired for the EMP simulators. For Project 2064, the impact is the reduction in analysis and facility hardware upgrades to support planned FY 1989 HAVE NOTE vulnerability assessments and the delay of further upgrades to support future millimeter-wave systems.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Project 1209, Nuclear Effects Simulation Test Facilities, is related to Program Element 0604711F, Systems Survivability (Nuclear Effects). Work performed under Program Element 0604711F develops techniques for the vulnerability assessment, testing, and hardening of weapon systems to all nuclear effects, while Project 1209

implements a testing capability for one specific nuclear effect, EMP. The Air Force Weapons Laboratory is responsible for coordinating these efforts. Project 2064 (HAVE NOTE) is the Air Force implementation of the Special Electromagnetic Interference Project, an initiative of the Office of the Under Secretary of Defense for Research & Engineering, which directs all three services to test their air-launched weapons for electromagnetic interference and to share test results and conclusions. Tri-service reviews are held periodically. In addition, HAVE NOTE supports research in the area of system/component vulnerability to high-power microwave radiation, which is funded under Program Elements 0602601F, Advanced Weapons, and (beginning in FY 1988) 0603605F, Advanced Radiation Techniques..

6. (U) WORK PERFORMED BY: Project 1209 is managed by Air Force Systems Command (AFSC) through the Air Force Weapons Laboratory (AFWL), Kirtland Air Force Base, NM. BDM International, Inc., McLean, VA, is the facilities support contractor. Project 2064 is managed by AFSC through Rome Air Development Center (RADC), Griffiss Air Force Base, NY. The test support contractor is Rome Research Corp., New Hartford, NY. RADC also has contracts with Advanced Electromagnetics, Albuquerque, NM, and the University of Colorado, Colorado Springs, CO, for methodology development efforts.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 1209, Nuclear Effects Simulation Test Facilities. This program is for development, acquisition, and baseline support of test facilities which simulate the nuclear electromagnetic environments in which weapon systems may be required to operate. The principal nuclear simulation facilities are the vertically and horizontally polarized electromagnetic pulse (EMP) dipoles and the in-flight EMP simulation facility (TRESTLE). These facilities are used to test aircraft and missile systems. The AFWL/Los Alamos Electromagnetic Calibration and Simulation Facility, a high-level, bounded-wave simulator of comparatively small volume, is used to test small missiles and communications equipment. Additional capabilities include portable EMP generators for remote site tests and a laboratory used for testing of individual electronic components. In FY 1987, evaluation of the French Astarte command post aircraft (sponsored by Naval Air Systems Command) continued. Other systems evaluated included the TORNADO aircraft for Defense Nuclear Agency (DNA), the HIS-2 (VH-3) Helicopter (retest) for the Naval Air Development Center, and the UH-60A Blackhawk helicopter (retest) for the Army and Defense Nuclear Agency. Also in FY 1987, AFWL began detailed planning for the FY 1988 B-1B test. In addition, the Laboratory continued to support the EMP Test Aircraft (EMPTAC)--which is an AFWL testbed for a variety of technology projects in the area of EMP hardness design, maintenance, and surveillance--and other technology programs, and continued the upgrade of data acquisition and processing systems. This upgrade will be completed in FY 1988. Subsequently, the B-1B will be tested on both the Horizontally and Vertically Polarized Dipoles as well as on the TRESTLE Facility. Other systems scheduled to be tested in FY 1988 are the EC-135 aircraft and the Small Intercontinental Ballistic Missile (ICBM) Hard Mobile Launcher for the Air Force, the OH-58C Helicopter for the Army, and the E-6A aircraft for the Navy. A second Astarte aircraft will be tested. Support to the EMPTAC and other technology programs will continue. In FY 1989, AFWL will continue testing of the Small ICBM Hard Mobile Launcher, test a third Astarte aircraft, and begin testing of both the C/EC-17 and KC-135 for the Air Force. Support to EMPTAC and other technology programs will continue. Maintenance and spares provisioning for the new data acquisition system will be less than that necessary to maximize data acquisition rates during tests and minimize test costs to customers. The

estimated costs are based on past program experience, adjustments for expected cost growth, and the workload projected to support the above projects. The requirement to test weapons systems for survivability to EMP is continuing.

B. (U) Project: 2064, HAVE NOTE. This program is for development, acquisition, and support of test facilities which simulate the non-nuclear electromagnetic environments in which weapon and command, control and communication ($C^3$) systems must be able to operate. Air-launched weapons and $C^3$ systems are tested in these facilities to assess their susceptibility to non-nuclear electromagnetic radiation (EMR) from hostile or friendly sources such as radios, radars, jammers, or other electronic devices. For periods of time comparable to the duration of a mission, these facilities can illuminate the weapon with a replica of environments it may encounter in flight. The principal non-nuclear test facility is the Electromagnetic Compatibility Analysis Facility (EMCAF), an anechoic chamber where air-launched weapons can be radiated by a variety of signals. In addition to its primary use in characterizing system susceptibility, the test data is also used to update test methods, acquisition specifications, design standards, and maintenance technical orders to ensure that the weapon system is immune to those radio frequency emanations which it may encounter during its life cycle. In FY 1987, the evaluation of the AMRAAM FSD model was completed, full EMR testing of the DSU/33B Proximity Fuze was conducted, and the Imaging Infrared (IIR) Maverick underwent high-power microwave (HPM) testing. RADC completed the installation of the Rapid-Evaluation Chamber, and the National Bureau of Standards began characterization of the facility. The chamber was activated for continuous wave testing. In FY 1988, RADC will complete HPM testing of the IIR Maverick and conduct EMR testing of the AGM-130 (powered version of the GBU-15 Glide Bomb). The Center will complete test planning for the Infrared Search and Track (IRST) System and the Sensor-Fuzed Weapon (SFW), and will begin actual testing. Initial operational capability of the Rapid-Evaluation Chamber will be achieved, following the completion of facility characterization. RADC will continue facility upgrades of the EMCAF to attain an improved vulnerability assessment capability against new or projected threats, including HPM. Facility upgrades, to meet special, rapid-sequence test requirements for advanced weapon systems with operating time limitations, will continue. RADC will upgrade test methodologies and data bases for expected EMR environments to keep pace with new test requirements and the advancing threat. In FY 1989, testing of the IRST System and SFW will continue, and initial EMR assessments for the AMRAAM Product Enhancement Program will begin. Test planning for the AGM-130 Improved Data Link (IDL) will begin, with actual testing beginning in FY 1990. The testing of weapon systems for survivability in non-nuclear electromagnetic environments is a continuing requirement. The estimated costs are based on past program experience, adjustments for expected cost growth, and the workload to support the above projects.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604755F    Title: Improved Capability for DT&E
DOD Mission Area: 451 - Major Ranges and Test Facilities    Budget Activity: 6 - Defense Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Addtional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 76,727 | 52,296 | 50,708 | Continuing | N/A |
| 2871 | Global Positioning System/Time-Space position Information (GPS/TSPI) | 22,519 | 0 | 0 | 0 | 45,293 |
| 2880 | 4950th Test Wing | 13,914 | 11,216 | 3,076 | Continuing | N/A |
| 3120 | Armament Divison | 11,740 | 10,987 | 13,709 | Continuing | N/A |
| 3285 | Arnold Engineering & Development Center (AEDC) | 5,390 | 0 | 2,176 | Continuing | N/A |
| 3323 | Cruise Missile Mission Control Aircraft (CMMCA) | 5,277 | 14,600 | 15,935 | 18,343 | 54,400 |
| 3324 | HAVE LINK | 3,100 | 3,070 | 4,194 | Continuing | N/A |
| 3620 | Air Force Flight Test Center (AFFTC) | 11,636 | 12,423 | 11,618 | Continuing | N/A |
| 3678 | Speckled Trout | 3,151 | 0 | 0 | 0 | 3,151 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the system upgrades and new systems required to adequately test and evaluate weapon and support systems in development. The program includes the engineering, development, acquisition and installation of significant new test range and instrumentation systems required to insure that the Department of Defense (DOD) Major Range and Test Facilities Base (MRTFB) test and evaluation technology is compatible with the systems it is required to test. The MRTFB is a national asset which is operated and mainatained primarily for DOD test and evaluation missions, but is also available to other users having a requirement for its unique capabilities. Test facilities improvements funded within this program include improvements to wind tunnels, rocket test cells, space chambers, armament ranges, climatic test facilities, avionics test facilities, and extensive instumented ranges. Test and evaluation support is provided to the Air Force, other Services, government agencies, commerical industry, and foreign customers.

3. (U) COMPARISION WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 73,227 | 64,663 | 71,257 | Continuing | N/A |

EXPLANATION: (U) The current funding level reflects FY 88 Appropriations Act and current OSD fiscal guidance.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Improved Capability for DT&E program supports the Test and Evaluation Support Program (PE 0605807F). Most PE 0604755F projects were originally contained within PE 0605807F. PE 0604755F contains funding for high priority range support projects. Prototype and low rate intial production of Global Positioning System/ Time-Space Postioning Information equipment is contained within PE 0604940D, Test Instrumentation-Development. In addition, the improved capabilities benefit all weapon systems test programs which come to the ranges and centers.

6. (U) WORK PERFORMED BY: The improvement and modernization projects contained in this program are the responsibility of the applicable range/center/product division. These Air Force organizations are Arnold Engineering and Development Center (Arnold AFS, TN), Armament Division (Eglin AFB, FL), Air Force Flight Test Center (AFFTC) (Edwards AFB, CA), and 4950th Test Wing (Wright-Patterson AFB, OH). Major contractors and associated projects are: Applied Physics Laboratory/Johns Hopkins University, Laurel, MD (Sonobuoy Missile Impact Location System); E-Systems, Greenville, TX (Advanced Range Instrumentation Aircraft--sonobuoy launch system only); Computer Science Corporation, Lompoc, CA (Integrated Facility for Avionics Systems Test); VERAC Incorporated, San Diego, CA (Advanced Range Data System); and Southern Research Incorporated, Birmingham, AL (Seeker Development).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2880, 4950th Test Wing (4950 TW): The 4950th Test Wing, Aeronautical Systems Division, Wright-Patterson AFB, OH, performs flight tests of aircraft and airborne systems, supports space vehicle tracking for the Air Force Systems Command's (AFSC) Space Division, other DOD agencies, and the National Aeronautics and Space Administration. The Wing has the capability to conduct full-scale engineering evaluations, airborne instrumentation and data reduction, flight test aircraft modification and extensive technical photo documentation. Staging out of 13 overseas bases, the Advanced Range Instrumentation Aircraft (ARIA) provides telemetry support for the National Aeronautics and Space Administration and DOD missile launches out of Cape Canaveral, FL, and Vandenberg AFB, CA. Improvement and modernization efforts include: ARIA Upgrade, Palletized Digital Avionics Recording Test System (PDARTS), Integrated Data Facility (IDF), and Computer Aided Engineering (CAE). ARIA upgrade is a continuing program to ensure support of test user requirements. The current program converts previously purchased C-18 (used Boeing-707/320) aircraft to the ARIA EC-18B configuration including upgrades of onboard data-processing equipment to meet the increased sensitivity and data rate requirements of the users. PDARTS will integrate and flight test software-intensive avionics systems, providing a capability to perform fully instrumented, developmental flight test of digital avionics at the component level. The Integrated Data Facility (IDF) will consist of a ground-based laboratory module, a real-time test data monitoring module and a module for improved data computation and analysis. Computer Aided Engineering (CAE) is a tool used by engineers, designers, and Computer Numerically Controlled (CNC) Machine programmers to create, develop, and fabricate design. CAE provides intelligent design tools which incorporate expert systems technology, designs standards, specialized analysis programs, and geometric/physical property calculation capabilities. The Electronic Counter-Countermeasures (ECCM) Advanced Radar Testbed will provide an airborne platform to support design and testing of new and improved radar systems. In FY 1987, the first article ARIA system was fabricated, airworthness test and flight test plans were developed and finalized, and inplant testing of the first

article began. Production sonobuoy launch tubes and instrumentation was installed during aircraft modification and optics development continued. One EC-18B ARIA will roll out. PDARTS design will be completed. A study contract will be awarded to perform technical analysis of the IDF. CAE equipment purchases and planning efforts will continue. In FY 1988, ARIA optics upgrades will include first article test and production delivery of optics kits. The meteorological effort will include completing the procurement of remaining instrumentation, perform sonde (weather measurement device) separation tests and systems flight testing, complete procurement package and contract award for production sondes. The fourth EC-18 to be coverted will begin operation. PDARTS development support, purchase of equipment, modification and flight testing integration and checkout will continue. IDF hardware acquisition commences. CAE major system purchase is planned. A multi-year competitive contract will be awarded in the first quarter of FY 1988 with system deliveries throughout FY 1990. In FY 1989, the second EC-18 will receive the remainder of the ARIA modification after completion of the SMILS prototype testing and roll out in FY 1989. SMILS Launch tubes will be installed and instrumentation modifications will continue in FY 1989. PDARTS integration and checkout, IDF hardware acquisition, and CAE equipment procurement will continue. New capabilities will include the use of expert systems in structural design and analysis, electronic circuit simulation, integrated circuit design, and support of 5-axis CNC machining. Final system configuration will include 54 stand-alone CAE workstations, peripheral equipment, and a local area network to allow for the sharing of data and on-line storage of released engineering data.

B. (U) Project: 3285, Arnold Engineering and Development Center (AEDC): AEDC, Arnold AFS, TN, provides ground environmental test support for Air Force aeronautical, missile and space programs as well as other DOD agencies, government agencies and industry programs, The center has three facilities comprised of wind tunnels, altitude rocket and turbine cells, arc heaters, aeroballistic ranges, space chambers plus administrative and technical support facilities. The test facilities are: Von Karman Gas Dynamic Facility (VKF) which performs aerodynamic testing of scale model aircraft, missile and space systems from Mach 1.5 to 10.0, testing of large and full-scale satellites, sensors and space vehicles in a simulated space environment and projectiles (both high performance and conventional guns) at various altitudes and reentry conditions; Engine Test Facility which provides altitude environmental testing for aircraft, missile and spacecraft propulsion systems including turbojets, turbofans, and both liquid and solid propellant rockets; and Propulsion Wind Tunnel Facility (PWT) which provides testing of large-scale models, and in some cases, full scale engine inlet combinations, missiles and space boosters together with their propulsion systems at Mach numbers from 0.5 to 4.5. The Center also supports programs of the National Aeronautics and Space Administration (NASA), such as Space Transportation System, the Army Ballistic Missile Division and the Navy, as well as technology support to the Department of Energy. The Center's facilities are national assets that provide unique test capabilities not available elsewhere. Improvement and Modernization efforts for Arnold Engineering and Development Center (AEDC) keep these unique test capabilities abreast of the weapon system technology currently under test. In FY 1987, phase three of the AEDC Computer Enhancement Program continued to provide real-time data processing and state-of-the-art capabilities. Plant automation for the basic and additional refrigeration controllers in Environmental Test Facility will be installed. Dynamic data acquisition systems was procured to provide capability to support dual cell concurrent operations and reduce cell turnaround time. Test Area Control systems in the turbine cells were activated and validated. FY 1989 through FY 1992 project funding includes the final phase of the Facility Computer Enhancement Program, data system improvements, facility plant upgrades, and test article control improvements, which will continue to significantly enhance AEDC's testing capabilities.

C. (U) Project: 3324, HAVE LINK: The Air Force HAVE LINK program implements Office of the Secretary of Defense direction to protect weapons systems design information and test data on test ranges. The HAVE LINK program implements corrective measures to eliminate identified vulnerabilities subject to exploitation by hostile intelligence collection agencies. The FY 1987 program addressed the most urgent vulnerabilities, corresponding to information of high value and collection at low risk to the collector. Project 3324 specifically addresses vulnerabilities at AEDC, Aramament Division (AD) Eglin AFB, FL, Air Force Flight Test Center (AFFTC) Edwards AFB, CA, and Aeronautical Systems Division (ASD) Wright-Patterson AFB, OH. Implementation for the Eastern Space and Missile Center, the Western Space and Missile Center, Utah Test and Training Range, and 6585 Test Group is funded within PE 0708022F, PE 0708Q32F, PE 0708019F, and PE 0605708F respectively. HAVE LINK is a level of effort program. FY 1988 and FY 1989 funds will purchase equipment to continue efforts begun in FY 1987. Specifically, funds will support secure voice communications, telemetry encryption, secure video, data and radio transmission equipment, and upgrades to existing facilities to meet TEMPEST requirements.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3120, Armament Division (AD)

A. (U) Project Description: AD is located at Eglin AFB, FL, and is responsible for Air Force nonnuclear armament development. AD, as the USAF focal point for munitions integration into aeronautical systems, conducts and supports USAF weapons effectiveness testing, electronic combat testing, electronics surveillance and control testing, and aeronautical systems testing. AD uses over 50 instrumented test areas, sites, and ranges, operates the McKinley Climatic Laboratory, and operates 41 aircraft of seven different types. Improvement and modernization efforts include: Seeker Development, Computer Sciences, Multipurpose Range Systems Upgrade, Armament Systems Test Environment (ASTE) Upgrade, and Airborne Radar Electronic Counter-Countermeasures (ECCM). Seeker Development provides laboratory, field, and airborne instrumentation to support development testing of precision guided weapons and aircraft systems. Computer Sciences includes acquisition of subsystems to improve and modernize the Eglin computer sciences facility. Multipurpose Range Systems Upgrade provides for upgrading Airborne Instrumentation and Multipurpose Instrumentation (MPI) systems to meet the test requirements of increasingly complex weapons systems. ASTE Upgrade provides for the modernization of the major data collection systems for weapons test missions to enhance the ability to define lethality and safe separation characteristics for aircraft cannon, rocket, and missile munitions.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Seeker Development: Expansion of seeker Development Test and Evaluation capability continued with the Seeker Evaluation Test Simulation Facility (SETS) and the scenario range. Both the Infrared Algorithm Simulator and the Weapons Survivability Instrument System became operational in FY 1987, and major upgrades took place in seeker vulnerability test capability to include countermeasures and obscurant systems. Computer Sciences: Procurement of advanced display equipment continued in support of the Centralized Control Facility. Optical assessment equipment was procured. Telemetry data reduction equipment was upgraded. MPI Range Systems Upgrade: AIM-9 Camera Pod procurement was continued. Wideband data transmission systems (fiber optics systems) and support equipment purchases was initiated. ASTE Range Systems: Video and remote control was added to cinetheodolites, as well as

computer-aided tracking capability. New cameras and an accelerometer calibration system were installed on the range.

(2) (U) FY 1988 Program: Seeker Development: A rate table will be developed for the Guided Weapons Evaluation Facility (GWEF) which will accommodate a variety of guided seekers and point source targets. Computer Sciences: A major objective of the Armament Division is to develop the capability to execute two major missions simultaneously. The necessary computer hardware to support the required twelve-stream telemetry capability must be acquired in early FY 1988 in order to implement software needed to perform both range systems test and evaluation and operational real-time and post-mission data processing. Multipurpose Instrumentation (MPI) Range Systems Upgrade: The buildup of the range telemetry dual-mission capability will be continued. Upgrades of support systems including the sled track capability, radiometers, timing/video equipment and weather instrumentation will be accomplished. Replacements of unsupportable analog microwave (MW) systems with digital MW systems and replacement of over 300 single-channel, tube-type range radios with four-channel modern radios will also take place. Also to be upgraded are wideband data transmission equipment, weather sensors and test/calibration equipment and Infrared resolution test capability. The FY 1988 Preflight Integration of Munitions and Electronics Systems (PRIMES) facility will be upgraded with a second RF test unit and aircraft interface instrumentation required to test the critical directional power management features of Radar Warning Receiver Systems (RWRS). Armament Systems Test Environment (ASTE) Upgrade: Improvements will be made in the areas of cinetheodolites, range photo-optic cameras, high-speed video cameras, explosive instrumentation data systems, advanced warhead and fuze test systems, and laser trackers. Electronic Counter-Countermeasures (ECCM): Design and installation of test equipment on board a host C-141 aircraft will include operator stations, Line Replaceable Unit (LRU) test benches, generic test equipment, and interface equipment. Work also begins on the Armament Division electronic jammers and other range instrumentation such as radio frequency generators, receivers and supporting software.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Seeker Development: A Seeker Vulnerability Evaluation capability to test active infrared countermeasures will be procured in FY 1989 and a capability to test systems designed to detect and deactivate optical tracking systems will be started. Work will also begin to define the realistic level of countermeasure simulators, obscurant generators, and instrumentation required for the scenario ranges. Computer Sciences: Additional hardware will be acquired for secure real-time and post-flight data processing. Future efforts will continue acquisition of computer hardware for real-time mission analysis. MPI Range Systems Upgrade: Acquisition of computer hardware for real-time mission analysis will continue. ASTE Upgrade: Upgrade of cameras, high-speed video, explosive instrumentation data systems, advanced warhead and fuze test systems, and laser tracker improvements will continue. ECCM: FY 1989 efforts continue work begun in FY 1988.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3323, Cruise Missile Mission Control Aircraft (CMMCA)

A. (U) Project Description: The existing test support scenario for cruise missile testing requires a fleet of up to 17 aircraft to provide visual safety chase, telemetry collection and tanker support. Some cruise missile test

missions also require Airborne Warning and Control System (AWACS) aircraft for radar flight following. This support scenario is resource intensive and the visual safety chase precludes testing in other than visual meteorological flight conditions. The Cruise Missile Mission Control Aircraft (CMMCA) will consolidate telemetry support, mission control functions, and radar safety chase and flight following capabilities for cruise missile testing into a single C-18 airborne platform. Consequently, the CMMCA will reduce the requirements for visual chase, Airborne Warning and Control System (AWACS) and tanker support, and will allow cruise missile testing in instrument meteorological conditions. Although the CMMCA will replace visual safety chase for the majority of cruise missile test missions, developmental cruise missiles, and those containing classified payloads will still require a visual safety chase after launch. Two C-18 aircraft currently in the Air Force inventory will be configured to be CMMCA and, when operational, will support approximately 70 cruise missile test missions per year.

B. (U) Program Accomplishments and Efforts:

(1) (U) FY 1987 Accomplishments: System Specification and Request for Proposal (RFP) were prepared for the selection of the EC-18 CMMCA contractor. The CMMCA radar integration contract was awarded.

(2) (U) FY 1988 Program: The RFP will be released, proposals reviewed, and source selection will occur. Design of the aircraft modification will begin. Purchase of the GFE radars is also planned.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 projected activities include completion of the aircraft modification design, Critical Design Review and fabrication. Modification of the first EC-18 will be iniatiated.

(4) (U) Program to Completion: Modification of the first aircraft will be completed, testbed, and delivered to the 4950TW. Iniatial Operational Capability is planned to occur by the first quarter of FY 92 with delivery of the second CMMCA modified EC-18D to the 4950TW.

C. (U) Major Milestones:

| Milestones | Dates |
|---|---|
| (1) Requirements Study | 4th Quarter FY 1987 |
| (2) Contract Source Selection | 3rd Quarter FY 1988 |
| (3) Initial Operational Capability (First Aircraft) | 2nd Quarter FY 1991 |
| (4) Full Operational Capability (Second Aircraft) | 1st Quarter FY 1992 |

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 3620, Air Force Flight Test Center (AFFTC)

A. (U) Project Description: The AFFTC, located at Edwards AFB, conducts and supports development test and

evaluation and operational test and evaluation of aircraft and aircraft systems, aerospace research vehicles, unmanned miniature vehicles, cruise missiles and parachute delivery/recovery systems. Air Force parachute and cargo handling systems are also evaluated. Recovery support and engineering evaluation is provided to the Space Shuttle program and other transatmospheric vehicles. AFFTC operates two instrumented ranges: the Edwards Flight Test Range and the Utah Test and Training Range (funded in PE 0708019F). Additionally, AFFTC operates the USAF Test Pilot School which annually trains fifty DOD, allied and contractor test pilots, flight test navigators and flight test engineers. Improvement/modernization efforts include: Integration Facility for Avionics Systems Testing (IFAST), Integrated Flight Data Processing System (IFDAPS), Advanced Range Data System (ARDS), Modular Airborne Instrumentation System (MAIS), AFFTC Instrumentation Upgrade, Airborne Instrumentation Enhancement, Test Pilot School (TPS) Instrumentation Upgrade, Test Facility for Advanced Aircraft Systems (TFAAS), and Physical Measurement Facility (PMF). IFAST provides a multi-user support facility for full-scale avionics development test and evaluation. IFDAPS is a distributed processing system for Time Space Positioning Information (TSPI) and engineering unit data, based upon mini-computers which can be expanded with modular segments. ARDS is a highly accurate TSPI data and communications system for large areas beyond the present AFFTC range, with significant savings in manpower and range-support costs. ARDS takes advantage of the NAVSTAR Global Positioning System (GPS) and other satellite systems to provide the necessary position data and communications for multiple, simultaneous test vehicles. The MAIS project will develop a high data rate, pulse code modulation, airborne instrumentation system to meet the requirements of future test programs to be conducted at the AFFTC. The AFFTC Instrumentation Upgrade project will upgrade AFFTC range support systems which are becoming saturated. The Airborne Instrumentation Enhancement efforts will upgrade the present outdated, labor intensive calibration and printed circuit board (PCB) laboratory equipment used in support of airborne instrumentation with state-of-the-art equipment. The TPS Instrumentation Upgrade project will upgrade airborne instrumentation systems for TPS aircraft and the associated ground data facilities. Instrumentation and current TPS aircraft are aging and must be upgraded to provide more realistic, reliable, and effective training using current aircraft, equipment and techniques. TFAAS will allow ground testing of the entire aircraft's integrated network software, including all flight control features as well as all avionics. The PMF project will provide for major upgrade or development of physical measurement facilities at the AFFTC such as the weight and balance system, horizontal thrust stands, moment of inertia facilities, gun firing/boresight, remote calibration system, ground vibration/limit of cycle system, antenna pattern system, runway test facilities, and multi-dimentional thrust stand.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Integration Facility for Avionics Systems Testing (IFAST) completed F-16C/D full simulation and installation of hardware peripherals, adapt data processors to integrated performance, and develop documentation and training procedures. Advanced Range Data System (ARDS): Development of the central computer system, development of the high accuracy system, and planning for procurement and testing of the production articles. Production procurement began in early FY 1987. Air Force Flight Test Center (AFFTC) Instrumentation Upgrade: Development of an uninterruptible power supply for FTMCC. Mobile telemetry upgrades continued. Cinetheodolite ranging demonstration continues. Airborne Instrumentation Enhancement: Calibration and airborne instrumentation upgrades continued. The Integrated Flight Data a Processing System (IFDAPS) interface will be completed fourth quarter. TPS Instrumentation Upgrade: Initial Operational Capability (IOC) of the new ground systems were reached, as well as IOC for the post-flight system.

(2) (U) FY 1988 Program: IFAST integration engineering will be performed to properly interface the current IFAST capability with the new three bay addition. ARDS will continue acquisition support from the System's Engineering Technical Assistance (SETA) contractor, acquire a new system to support current high data requirements, buy initial GPS based instrumentation, and continue ongoing support to the Range Applications Joint Program Office. Modular Airborne Instrumentation System (MAIS) The preliminary acquisition strategy calls for competitive development contracts for a new system (demonstration/validation phase) to be awarded in FY 1988. AFFTC Range Instrumentation Upgrade procurement of an uninterruptable power source for the flight test mission control center and continued improvements of the enhanced voice communication switching system. Continued upgrade of the data transmission system between Edwards AFB and the Utah Test and Training Range. Also continued fiber optic installation for local data transmission. Continued upgrades to video systems and mobile telemetry receiving and distribution capabilities. Airborne Instrumentation Enhancement will continue upgrade of airborne instrumentation and laboratory calibration equipment, and upgrades will begin on assigned pacer aircraft to allow more accurate calibration of airspeed. TPS Instrumentation Upgrade will continue upgrade of the data processing system with IFDAPS equipment and purchase of additional telemetry equipment. Detailed planning for the acquisition and integration of the Test Facility for Advanced Aircraft Systems (TFAAS) will be completed. The Physical Measurement Facility (PMF) project will concentrate efforts on facilities causing O&M problems which can be upgraded relatively easy, and with relatively low dollar amounts. An effort will also be funded with the AFFTC Support Engineering and Technical Assistance (SETA) contractor to define and generate specifications for future upgrades. This funding is required in FY 1988 to alleviate the biggest problem areas and provide a planned, prioritized approach to accomplish future PMF upgrade/developments.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Integrated Flight Data Processing System (IFDAPS): FY 1989 funding will procure more Data Analysis systems, additonal real-time data analysis subsystems and initial spares. This will allow the Integrated Flight Data Processing System (IFDAPS) to support an increased number of simultaneous missions, standardize hardware and software and enable retirement of older systems. Future efforts include integration of the Structures and Flutter Subsystem, integration of the Instrumentation Calibration Work Station, additional Data Analysis Work stations, and associated initial spares. Advanced Range Data System (ARDS): Completion of development and initial procurement. Future efforts continue procurement. Modular Airborne Instrumentation System (MAIS): Development and fabrication of up to two prototypes from one or more contractors to be flight tested in FY 1990. Implementation of prototype modification (full scale development) and production with associated support will be negotiated as a follow-on contract with a single contractor. Air Force Flight Test Center (AFFTC) Instrumentation Upgrade: FY 1989 and future funding will continue efforts begun in FY 1988. Airborne Instrumentation Enhancement: In FY 1939 and out upgrades of instrumentation will continue. Test Pilot School (TPS) Instrumentation Upgrade: New components and transducers along with the new airborne instrumentation will be installed through FY 1989-FY 1992 to support the TPS. Test Facility for Advanced Aircraft Systems (TFAAS): Planning will continue in FY 1989 with contract award anticipated in FY 1990 for a contract to provide the processing/simulations/ display hardware/software. Initial Operational Capability (IOC) for the facility is planned for 1993. Physical Measurement Facility (PMF) funding will continue evaluation and scoping the project. Future efforts will include development and procurement of equipment upgrades.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

II. (U) COOPERATIVE AGREEMENTS: Not Applicable.

**AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY**

Program Element: #0605101F — Title: Project AIR FORCE
DOD Mission Area: #440 - Technical Integration/Studies & Analyses — Budget Activity: #6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 20,299 | 22,020 | 21,992 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program funds Project AIR FORCE (PAF), the AF Studies and Analyses Federally Funded Research and Development Center operated by The RAND Corporation. It provides for continuing analytical research across a broad spectrum of issues and concerns to the AF. By design, the PAF research agenda is focused primarily on mid- to long-term concerns. Results and analytical findings obtained from PAF directly impact senior management deliberations on major issues facing the AF. Also, written reports of research findings are widely distributed throughout the AF and defense community.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 20,300 | 19,106 | 20,011 | Continuing | N/A |

EXPLANATION: (U) FY 88 change due to Congressional authorization of 144 Members of Technical Staff (MTS--man years). FY 89 change due to CSAF increase to 137 MTS. Original requests were 125 MTS.

4. (U) OTHER APPROPRIATIONS FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PAF efforts span functional and organizational boundaries. As a result, the research conducted relates to a wide spectrum of AF activities. To assure relevance and to prevent unnecessary duplication, each newly proposed research effort is reviewed by the AF Assistant Chief of Staff for Studies and Analyses. The results are also deposited with the Defense Technical Information Center for appropriate dissemination to other qualified recipients.

6. (U) WORK PERFORMED BY: All work is performed by The RAND Corporation, Santa Monica, CA. The Air Force Advisory Group (AFAG), Chaired by the Vice Chief of Staff, reviews, monitors, and approves the PAF research effort. Director of Plans, DCS/Plans and Operations, is the PAF Executive Agent.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: PE #0605101F, Project AIR FORCE

A. (U) Project Description: PAF is a continuing research program. Based on a research plan approved each September, there are approximately 40 projects in various stages of implementation during each fiscal year. Each project is initiated, processed, and approved IAW AFR 20-9 which requires General Officer sponsorship and involvement on a continuing basis. The research effort encompasses a broad spectrum of aerospace policy and technical issues and is organized into the four research programs listed below.

B. (U) Program Accomplishment and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 research was keyed to major issues defined by the AFAG. Major accomplishments in each research program were:

(U) National Security Strategies: Major research in this project was focused into three major areas: strategic nuclear forces and arms control, allies and U.S. regional security interests, and Soviet-East European studies. Individual projects examined Soviet concepts of nuclear war, U.S. strategic targeting objectives and challenges, Soviet response to SDI, alternative ways to implement a forward strategy in Europe, problems of delayed permission for U.S. units to deploy to European operating bases, conventional arms control (particularly in light of INF negotiations), Soviet military-civilian relationships, and the Soviet mechanisms which control the Warsaw Pact.

(U) Force Employment: This project concentrated on three major themes: winning the air war in Central Europe, supporting the land battle in Central Europe, and enhancing the deterrence of strategic forces. Individual studies examined possible responses to Soviet forward air defense deployments, defensive responses to low observable air vehicles, and electronic combat and interdiction concepts in Central Europe.

(U) Technology Applications: This project seeks to assess the technical risk and benefits of examined technology, evaluate synergistic effects of technical options while also examining cost, and provide recommendations regarding exploratory and advanced development and the acquisition of new or modified weapon systems. Projects concentrated in the areas of strategic operations, tactical interdiction, space operations, airbase defense, $C^2$ and system affordability. Included in these studies are examinations of the National Aerospace Plane, advanced conventional weapon systems for B-52s, and an assessment of antiproton utilization for future space propulsion.

(U) Resource Management: This project is built around three themes: enhancing combat capability by improving combat support and base structure, improving formal AF resource allocation and financial management policies and techniques, and integrating management and planning of manpower demand and supply. Projects examined alternative management policies to improve reliability and maintainability of AF weapon systems, new logistical support and $C^2$ structures to deal with logistics demand uncertainties, basing and related defense options to improve tactical sortie generation, enlisted force personnel policies, and resource allocation and financial management policies and techniques.

(2) (U) FY 1988 Program: In addition to those efforts continuing from FY 1987, particularly in the areas of deterrence, TACAIR in NATO, and combat support, research will focus on three integrative studies which will prepare for the issues likely to be raised during the transition to a new administration. These integrative studies will address major policy, employment, cost, and force modernization issues related to strategic forces, tactical forces, and SDI. PAF will also conduct research across the 12 major AF research issues designated by the AFAC.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program will build on planned FY 1988 efforts in accordance with AFAC guidance and direction. While specific topics will naturally evolve, PAF will continue to conduct research in those major areas where RAND can make unique contributions to the AF. Major research areas will include close air support issues and options, policy issues surrounding AF space operations, medical response to biological/chemical threats, application of advanced computer technology to aircraft maintenance, CENTCOM strategy for conventional conflict, and the role of Japan in U.S. Pacific strategy.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605306F
DOD Mission Area: 440 - Technical Integration/Studies and Analyses

Title: Ranch Hand II Epidemiology Study
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 7,147 | 5,754 | 1,747 | 76,385 | 110,673 |
| 2767 | Ranch Hand II Epidemiology Study | 7,147 | 5,754 | 1,747 | 76,385 | 110,673 |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The United States Air Force, under direction of the White House, is conducting a 20-year epidemiology investigation of Air Force personnel who were involved with aerial dissemination of herbicides in Vietnam from 1962 to 1971 (OPERATION RANCH HAND). The objective of this investigation is to determine whether long-term health effects exist and can be attributed to occupational exposure to phenoxy herbicides and their associated dioxins. This investigation was directed by the Assistant to the President for Domestic Affairs and Policy, through a 16 September 1980 memo to the Secretary of Defense. On 27 March 1981, the Office of Management and Budget confirmed the current administration's desire to continue the study as directed. The importance of this particular study to the dioxin question cannot be overestimated because the Air Force Ranch Hand personnel are the only human population for whom frequency and duration of exposure to the herbicide are known with any accuracy.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 7,147 | 5,777 | 1,757 | 76,385 | 108,673 |

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This is one of several federal studies designed to provide information regarding alleged claims of adverse health effects in Vietnam veterans exposed to Herbicide Orange. The studies include the Air Force study, the Veterans Administration study of twins, and the Centers for Disease Control study of birth defects. These studies are coordinated by an interagency Science Panel, established by the White House.

6. (U) WORK PERFORMED BY: Program controlled and monitored by the Human Systems Division. The United States Air Force School of Aerospace Medicine, Brooks Air Force Base, TX, assists in the monitoring and performs data base management and certain studies and analyses. Science Applications International Corporation, McLean, VA, conducts the Air Force Health Study Contract which includes physical exams, questionnaires, and statistical analyses.

Program Element: 0605306F
DOD Mission Area: 440 - Technical Integration/Studies and Analyses

Title: Ranch Hand II Epidemiology Study
Budget Activity: 6 - Defense-Wide Mission Support

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 2767, Ranch Hand II Epidemiology Study

A. (U) Project Description: The purpose of this 20-year study is to determine if long-term health effects exist in Air Force personnel who served in Vietnam and whether such effects might be attributed to occupational exposure to Herbicide Orange. The study involved a comparison of Ranch Hand personnel with Air Force crew members/support personnel serving in Vietnam who were not exposed to herbicides. Comparisons will be made on mortality rates, present and past health status, and future follow-up health status at the 3-, 5-, 10-, 15-, and 20-year periods. Detailed computer searches of Air Force and other Government record systems were used to identify and locate Ranch Hand personnel. A matched control subject was selected for each exposed study subject based on age, Air Force duty specialty, and race. Participation by exposed and comparison study subjects will continue to be on a voluntary basis. Study subjects participated in a comprehensive baseline physical examination in 1982, with emphasis on dermatologic, neuropsychiatric, hepatic, immunologic, reproductive, cardiac, and neoplastic conditions. Questionnaires reconstructing occupational, social, and medical data to quantify morbidity end points and possible confounding factors were administered.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The year-3 questionnaire and physical examination data was coded, analyzed, and the 1st follow-up morbidity report was published after review by the Science Panel in September 1987. The annual mortality analysis and the HQ USAF/SG directed fertility analysis continued. The year-5 follow-up study started in March 1987. By the end of FY 87, nearly 1500 participants had completed their follow-up exams and questionnaires. A new and revolutionary Serum Dioxin Assay pilot study was conducted in conjunction with the year-5 follow-up physicals, at White House direction. The pilot study clearly demonstrated the presence of high levels of dioxin within members of the study group and proved that an accurate quantitative indication of actual dioxin exposure can be shown by such an assay.

(2) (U) FY 1988 Program: The balance of the year-5 data (both physical examinations and questionnaires) will be collected during the first half of the year. Data base compilation will be completed and data analysis will commence. This work will form the basis of the second follow-up morbidity report. A fertility analysis commenced in FY 1986 will be completed by the end of FY 1988. The annual mortality analysis will continue.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Statistical analyses of the year-5 data will be completed. The year-5, second follow-up morbidity report will be published. The fertility analysis report will be published. The annual mortality analysis will continue. Data base management will continue. As a result of the successful Serum Dioxin Assay pilot study in FY 1987, the entire 2000-person Ranch Hand cohort group will have blood samples drawn for Serum Dioxin Assay. The Serum Dioxin Assay uses a new laboratory procedure which clearly

demonstrates the amount of dioxin in the body, without an invasive surgical procedure, and provides major validation and enhancement to the overall study by allowing direct correlation between dioxin exposure and observed health effects.

(4) (U) Program to Completion: Ten, 15 and 20-year follow-up morbidity studies are scheduled for 1992, 1997, and 2002; each participant will receive a thorough physical examination and be asked to complete an extensive questionnaire. Mortality analysis will continue every year through 2002. On an annual basis, data will be coded, entered into a data base file, analyzed and examined for statistical significance and medical inference. Findings and conclusions will be published in the USAF School of Aerospace Medicine Aeromedical Reviews and Technical Reports.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Release of year-3 morbidity report | | July 1987 |
| (2) (U) Start second follow-up (year-5) examinations | | March 1987 |
| (3) (U) Complete second follow-up examinations | *(January 1988) | March 1988 |
| (4) (U) Release of year-5 morbidity report | *(May 1989) | November 1989 |
| (5) (U) Obtain Serum Dioxin Sampling | | September 1989 |
| (6) (U) Complete longitudnal analysis | | September 1992 |
| (7) (U) Start third follow-up (year-10) examinations | *(March 1992) | January 1992 |
| (8) (U) Complete Serum Dioxin Assays | | September 1994 |

*Date presented in FY 1988/89 Descriptive Summary.

(U) Explanation of Milestone Changes

(3) (U) Completion of second follow-up (year-5) exam delayed 60 days due to higher than anticipated voluntary subject participation rate.
(4) (U) Release of year-5 morbidity report delayed due to 5 month delay in manditory Science Panel peer review.
(7) (U) Start third follow-up (year-10) examination 60 days early due to intentional schedule change.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605708F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: NAV/RADAR/SLED-TRACK Test Support
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 25,293 | 24,122 | 20,545 | Continuing | N/A |
| 06TG | 6585th Test Group Support | 21,293 | 20,122 | 17,445 | Continuing | N/A |
| 2900 | Radar Target Scatter (RATSCAT) Upgrade | 2,000 | 2,000 | 1,600 | Continuing | N/A |
| 688G | Aircraft Navigation System Verification | 2,000 | 2,000 | 1,500 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The 6585th Test Group at Holloman AFB, NM, and the associated facilities and modernization efforts funded here are part of the Department of Defense (DOD) Major Range and Test Facility Base (MRTFB). The MRTFB is a national asset which is operated and maintained primarily for DOD test and evaluation missions, but is also available to other users having a requirement for its unique capabilities. The unique MRTFB capabilities of the 6585th Test Group include the Central Inertial Guidance Test Facility, the Radar Target Scatter (RATSCAT) facility, and the High Speed Test Track. These facilities are necessary to support a wide range of high priority programs including B-1B, TRIDENT, Peacekeeper, Small Intercontinental Ballistic Missile (ICBM), Advanced Medium Range Air-to-Air Missile (AMRAAM) and various classified programs involving new technology.

3. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 21,294 | 24,194 | 24,959 | Continuing | N/A |

EXPLANATION: (U) Increase of funds in FY 1987 due to Air Force reprogramming of $3,999 for first year funding for RATSCAT Advanced Measurement System annual real property maintenance requirements and acquisition of a new generic sled for ICBM guidance system testing. FY 1989 reduction due to restructure of AF budget will delete half of the FY 1989 Improvement and Modernization program at the Holloman test facilities.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The 6585th Test Group supports testing for a wide range of high priority customer programs such as B-1B, TRIDENT, Peacekeeper, Small ICBM, AMRAAM and various classified programs involving new technology.

6. (U) WORK PERFORMED BY: The primary contractor, Dynalectron of Washington, D.C., operates and maintains the Radar Target Scatter (RATSCAT) facility.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989:

A. (U) Project: 2900, Radar Target Scatter (RATSCAT) Upgrade. The RATSCAT main site facility is an outdoor electromagnetic laboratory which measures radar cross-section (RCS) and antenna patterns on weapon systems and subsystems. These measurements are performed using subscale or full scale models, and in some cases actual air vehicles. RATSCAT main site is unique in its ability to characterize signatures and perform measurements on targets of all sizes. However, RATSCAT main site equipment and facilities are predominantly early 1960's vintage and need repair and modernization. The RATSCAT main site is located on the White Sands Missile Range on a dry lake bed made up of the same gypsum salts which form the adjacent White Sands National Monument. These salts are highly corrosive when combined with moisture, and have progressively deteriorated the RATSCAT buildings and equipment. The upgrade project addresses these facility deterioration and equipment issues by: (1) the time-phased replacement of outdated test equipment; (2) the addition of new technology equipment needed for state-of-the-art RCS testing; and (3) programming for future Military Construction Projects (MCP) to construct new permanent facilities designed to withstand the corrosive effects of the local gypsum environment. The RATSCAT upgrade effort for FY 1986 through FY 1989 will procure an automated multiple frequency radar, control and data acquisition system called the Integrated Radar Measurement System (IRMS). The IRMS is a major enhancement in main site test efficiency, expanding capability from manually conducted single frequency RCS measurement to simultaneous, multiple frequency testing controlled by a computer. A continuing RATSCAT main site upgrade program is planned because of the rapidly changing nature of the technology associated with RCS measurements. This program includes the new RATSCAT Advanced Measurement System (RAMS) completed in FY 1985, which will be maintained as the premier RCS facility in DOD.

B. (U) Project: 688C, Aircraft Navigation System Verification. This project conducts standardized tests and evaluations of inertial and inertially-aided aircraft navigation systems for DOD aircraft and weapon delivery systems. Project 688C provides common support for these efforts with a Completely Integrated Reference Instrumentation System (CIRIS) capability. Tasks undertaken by this project include: Inertial Navigation System (INS) Verification Testing, Aided INS Verification Testing, Velocity Sensor Verification Testing, Standard INS Qualification Testing, Form/Fit/Function Testing, management and maintenance of the CIRIS, and minor Improvement and Modernization of the systems as required to support both the project efforts and users with valid support requirements. In FY 1987 strapdown ring laser gyroscope (RLG) inertial systems were the primary technology evaluated. In FY 1987 and FY 1988, the verification and development testing of navigation systems will continue with emphasis on radar and stellar-aided inertial navigation systems. Upgrades to the CIRIS will focus on completion of a multiple frequency capability so that the CIRIS can simultaneously support multiple test programs without frequency interference, and acquisition of the Advanced Reference System (ARS) upgrade to the CIRIS. The ARS efforts for FY 1989 will consist of field testing the upgrade which includes incorporation of additional sensors such as Global Positioning System (GPS) and Tactical Air Navigation (TACAN) and miniaturization of the system into a five inch diameter AIM-9 Sidewinder pod for compatibility with additional aircraft. This is a continuing project.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06TC, 6585th Test Group Support

A. (U) Project Description: The 6585th Test Group is a tenant organization at Holloman AFB, NM, adjacent to the White Sands Missile Range. This project provides institutional funding for operations, maintenance, improvement, modernization, and personnel in the following four major areas. (1) The High Speed Test Track performs rocket sled testing of missile guidance, aircraft ejection systems, and conducts many other types of tests requiring realistic simulations of high acceleration or high velocity environments. The sled-track was used to perform measurements of the Peacekeeper guidance system under environmental stress conditions and has attained a world speed record of over Mach 8 while testing rain erosion degradation of reentry vehicles. The sled track is also vital for developmental testing of guidance subsystems. For the foreseeable future, the track is heavily committed to guidance testing for Peacekeeper and Small Intercontinental Ballistic Missile (ICBM) as well as TRIDENT D-5 guidance system and other non-guidance system testing. (2) The Central Inertial Guidance Test Facility (CIGTF) conducts numerous guidance related test efforts. Typical CIGTF test programs include inertial guidance systems for the Peacekeeper and TRIDENT missile systems, ring laser gyroscope (RLG) development, and gravitational measurements necessary for ballistic missile guidance system testing and development. (3) The Radar Target Scatter (RATSCAT) facilities, including the new RATSCAT Advanced Measurement System (RAMS), are used to measure radar cross-section (RCS) and antenna patterns on selected subscale and full-scale targets. (4) The 6586th Test Squadron provides operational and maintenance support for flight test aircraft staging out of Holloman AFB. Cargo/transport type test bed aircraft are required to support the CIGTF in performing test and evaluation of navigation systems and fighter aircraft are operated and maintained by the 6586th Test Squadron in support of missile development tests conducted on White Sands Missile Range. In addition, the 6585th Test Group performs liason duties for USAF activities on the White Sands Missile Range, and performs full Federal Aviation Administration coordination for all airspace users in the White Sands Missile Range and Holloman AFB flying areas.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Major programs which were supported included Radar Cross-Section (RCS) tests for the Drone Design Test program and numerous USAF-directed efforts; testing of the Peacekeeper, Small Intercontinental Ballistic Missile (ICBM), and TRIDENT guidance systems; rocket sled tests of the Advanced Concept Ejection Seat (ACES) II Escape System, Crew Escape Systems Technology (CREST), Advanced Medium Range Air-to-Air Missile (AMRAAM), High Endo-Defense Interceptor (HEDI), Vertical Shock Isolation System (VSIS), the F-111 Crew Escape System, the Advanced Dispenser Technology program, and the Short Range Attack Missile (SRAM) II. Radar cross-section (RCS) testing for AMRAAM, Small ICBM, and SRAM II were completed, as were the ongoing Inertial Navigation System (INS) verification efforts under Project 688G.

(2) (U) FY 1988 Program: The 6585th Test Group will continue to support many of the prior year programs into FY 1988. These will include rocket sled tests of the SRAM II, ACES II Escape System, AMRAAM, the F-111 Crew Escape System, CREST, and HEDI; RCS tests for AMRAAM, Small ICBM, and numerous USAF-directed efforts; and ongoing INS

verification efforts under Project 688C. Other programs scheduled in FY 1988 are guidance tests for the Ground Launched Cruise Missile and a helicopter INS for the Canadian National Defence Headquarters. The improvement and modernization of test equipment for all three test divisions will continue in order to keep pace with technology advances. Real Property and Real Property Installed Equipment (RPIE) repairs and improvements will begin in FY 1988 for the new Radar Target Scatter (RATSCAT) Advanced Measurement System (RAMS) facility. In order to maintain RAMS as a viable, highly accurate RCS measurement facility, additional funding for repairs and improvements are urgently required. Range characterization measurement recently performed at RAMS indicates that the capability to measure low target signatures has begun to degrade due to the desert environment and, if this condition is not corrected, RAMS will no longer be able to make the critical measurements required by Advanced Tactical Fighter (ATF) and other programs with similar requirements. A continuing program of periodic maintenance is required to preclude further deterioration and costly repairs.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Support for the test missions, maintenance and upgrades will continue. Project support from prior year programs will continue and a substantial effort from all divisions in support of the Strategic Defense Initiative is anticipated. Major programs to be supported include Peacekeeper, SRAM II, ACES II, ATF ejection seat systems, Joint Surveillance Target Attack Radar System, and B-52 and B-1B avionics. Full occupancy and usage of the new RATSCAT facility will occur. A new radar system will be installed at RATSCAT Main Site to enhance capabilities for measuring radar cross-sections. A new data acquisition and processing system for telemetry data will be acquired for the sled track to streamline data flow. Consolidation of fabrication shops which support sled track testing is planned; this consolidation is expected to increase efficiency of track operations and improve working conditions.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605807F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: Test and Evaluation Support
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 302,302 | 295,106 | 298,087 | Continuing | N/A |
| 06RB | Arnold Engineering & Development Center (AEDC) | 145,359 | 143,070 | 145,271 | Continuing | N/A |
| 06ZA | Armament Division (AD) | 49,502 | 53,308 | 49,690 | Continuing | N/A |
| 06YA | Air Force Flight Test Center (AFFTC) | 63,778 | 59,259 | 60,342 | Continuing | N/A |
| 06UC | 4950th Test Wing (4950 TW) | 43,663 | 39,469 | 42,784 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Test and Evaluation Support program provides resources to operate the above Air Force test activities which are included in the Department of Defense (DOD) Major Range and Test Facility Base (MRTFB). The MRTFB is a national asset which is operated and maintained primarily for DOD test and evaluation missions, but is also available to other users having requirements for its unique capabilities. Test facilities funded within this program include wind tunnels, rocket test cells, space chambers, armament ranges, climatic test facilities, avionics test facilities, dry lakebed landing sites, and instrumented ranges. Test and evaluation support is also provided to other government agencies, commercial industry, and foreign customers. Major DOD programs supported include Peacekeeper, TRIDENT, Pershing, Advanced Medium Range Air-to-Air Missile, B-1B, F-15 and F-16.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 291,729 | 304,839 | 316,669 | Continuing | N/A |

EXPLANATION: (U) Current funding level reflects FY 1988 Appropriations Act, and curent Department of Defense Fiscal Guidance.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The test organizations provide test and evaluation support to Air Force programs and those of other Services and government agencies. Examples include the Air Launched Cruise Missile, F-15, F-16, Peacekeeper, Inertial Upper Stage and Space Transportation System. Additional related activities are covered under each project. Depot Maintenance Industrial Funds to support Air Force Systems Command test and evaluation aircraft is contained in PE 0605863F, RDT&E Aircraft Support. Technical capability improvement and modernizaton tasks are funded in PE 0604755F,

Improved Capability for DT&E. Beginning in FY 1987 base operating support funding for Arnold Air Force Station (AFS), TN, Eglin AFB, FL, and Edwards AFB, CA, was transferred to PE 0605894F, Real Property Maintenance RDT&E, and PE 0605896F, Base Operations (RDT&E), in compliance with the FY 1985 Appropriations Conference Report.

6. (U) WORK PERFORMED BY: Primary contractors performing test support at each center, shown in parentheses, include: SVERDRUP Technologies, Inc., Schneider Services, Inc. and Calspan Field Services, Inc. (AEDC); RCA Service (AD); and Computer Science Corporation (CSC) (AFFTC).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06RB, Arnold Engineering and Development Center (AEDC)

A. (U) Project Description: AEDC, located at Arnold AFB, TN, provides ground environmental test support for Air Force aeronautical, missile and space programs as well as other DOD agencies, government agencies and industry programs. Major programs supported include Minuteman, Peacekeeper, F-15, B-1B, Air Launched Cruise Missile, F-16, Short Range Attack Missile II and Advanced Ballistic Reentry Systems. The center has three test acilities comprised of wind tunnels, altitude rocket and turbine engine cells, arc heaters, aeroballistic ranges, space chambers plus administrative and technical support facilities. The test facilities are: (1) Von Karman Gas Dynamics Facility which performs aerodynamic testing of scale model aircraft, missile and space systems from Mach 1.5 to 10.0, testing of large and full-scale satellites, sensors and space vehicles in a simulated space environment and tests of projectiles (both high performance and conventional guns) at various altitudes and reentry conditions; (2) Engine Test Facility which provides altitude environmental testing for aircraft, missile and spacecraft propulsion systems including turbojets, turbofans, and both liquid and solid propellant rockets; and (3) Propulsion Wind Tunnel Facility which provides testing of large-scale models, and in some cases, full scale engine inlet combinations, missiles and space boosters together with their propulsion systems at Mach numbers from 0.5 to 4.5. The center also supports programs of the National Aeronautics and Space Administration (NASA), such as Space Transportation System, the Army Ballistic Missile Division and the Navy, as well as technology support to the Department of Energy. The Center's facilities are national assets that provide unique test capabilities not available elsewhere.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Arnold Engineering and Development Center provided vital aerospace ground/environmental test support to many of the nation's highest priority program, such as Peacekeeper, Small Intercontinental Ballistic Missile (SICBM), Minuteman, Seek Eagle, NASP, Boost Glide Vehicle, Advanced Tactical Fighter, F-15, F-16, Strategic Defense Initiative (SDI), and Short Takeoff, Landing and Maneuver (STOLM) Fighter Technology. Turbine engine programs supported included the F109, the F100 Engine Model Derivative Program/Component Improvement Program (CIP), and F110 CIP. Other aerospace propulsion, flight dynamics, materials testing, and munitions development testing was provided to NASA, Army, Navy, and other government agencies and industry. The Aeropropulsion Systems Test

Facility (ASTF) completed its first customer test program for the Joint Technology Demonstrator engine (JTDE). Design for the J-6 Large Rocket Test Facility continued, surpassing the 35% design point in August 1987. Beginning in FY 1987, base operating support (BOS) funding and real property maintenance activity funding (RPMA) was transferred to PEs 65894F and 65894F respectively in compliance with the FY 1985 Appropriations Conference Report.

(2) (U) FY 1988 Program: Major test efforts are planned to support Peacekeeper, SICBM, Inertial Upper Stage (IUS), BSTS, SSTS, Intelsat VI, NASP, STOLM Fighter Technology, F-16. F-15, B-1B, Minuteman, Joint Cruise Missile, SDI, and the ATF. Turbine engine programs schedule include F100 Improved Performance Engine (IPE)/CIP, F100 CIP, and the AFWAL Expendable Turbine Engine Concept (ETEC). Continued support will be provided in flight dynamics, aeropropulsion, space systems, and munition development for the Army, Navy, AFLC, NASA, other government agencies and industry. The ASTF facility will begin competitive testing of the two prototype engines for the ATF. Efforts to improve test methodology and to upgrade existing test capabilities will continue. Costs will increase in this timeframe because of inflation, increased requirements for operating contractor support, and rising utility costs. Design of the J-6 Large Rocket Test Facility will continue.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: AEDC will continue to contribute significantly to the successful and timely development of DOD weapons systems and technologies including Peacekeeper, SICBM, ATF, SSTS, STOLM, Minuteman, SDI, NASP, High Endoatmospheric Defense Interceptor (HEDI), and classified programs. Emphasis on turbine engine testing will involve the F100 IPE/CIP, ATF prototype engines and the AFWAL ETEC. Continued support will be provided in the areas of flight dynamics, aerospace propulsion, ordnance technology, and space systems for Army, Navy, NASA, other government agencies and industry programs.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06ZA, Armament Division (AD)

A. (U) Project Description: AD is located at Eglin AFB, FL, and is responsible for Air Force nonnuclear armament development. Eglin AFB, located in northwest Florida, is the largest Air Force base, encompassing 724 square miles of land test area and 86,500 square miles of water test ranges extending almost 240 miles south into the Gulf of Mexico. AD accomplishes technology research, engineering development, test, evaluation, and initial acquisition of USAF nonnuclear munitions. AD, as the USAF focal point for munitions integration into aeronautical systems; conducts and supports USAF weapons effectiveness testing, electronic combat testing, electronics surveillance and control testing, and aeronautical systems testing. Examples of test programs include: Advanced Medium Range Air-to-Air Missile (AMRAAM), the Airborne Self Protection Jammer (ASPJ), the French Durandal runway cratering munition; and environmental testing of entire aircraft in the McKinley Climatic Laboratory. To accomplish its mission, AD utilizes over 50 instrumented test areas,

sites, and ranges, and operates 43 aircraft of eight different types. The range resources are divided into four general categories: Armament Systems Test Environment, Electromagnetic Test Environment, Multipurpose Instrumentation, and the Water Test Areas. The aircraft used are F-4s, F-15s, F-16s, F-111s, A-10s, T-38s, UH-1Ns, and C-130A. The test and evaluation effort is funded under this program element. Other AD personnel are funded under PE 65806F, Acquisition and Command Support. Beginning in FY 1987, base operating support funding for Eglin AFB, FL, was transferred to PE 65894F, Real Property Maintenance (RDT&E), and PE 65896F, Base Operations (RDT&E), in compliance with the FY 1985 Appropriations Conference Report.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Armament Division (AD) funding continued to support critical test and evaluation efforts for developing nonnuclear munitions and electronic combat systems. AMRAAM, ACM-130, I-2000, F-15/F-16 Seek Eagle, ASPJ, and PLSS testing continued in FY 1987. Additional test programs supported in FY 1987 included the F-16 multi-role fighter, the AIM-9P-4/AIM-9L seeker certification and comparison, the Infrared Search and Track System, the Aircrew Eye and Respiratory Protection flight demonstration, and the AN/ALR-56C Radar Warning Receiver. Beginning in FY 1987, base operating support funding for Eglin AFB, FL, was transferred to PE 65894F, Real Property Maintenance (RDT&E), and PE 65896F, Base Operations (RDT&E), in compliance with the FY 1985 Appropriations Conference Report.

(2) (U) FY 1988 Program: AD projects supporting over 600 programs in FY 1988. FY 1988 funds represent the minimum necessary for adequate support of firm development test and evaluation commitments for conventional munitions and electronic combat systems needed by the using commands. In addition to continuing F-15 and F-16 munitions certification projects (Seek Eagle), AMRAAM, AN/ALR-56C, AIM-9P-4, and F-16 multi-role fighter tests, AD will begin testing the Hypervelocity Missile Demonstration and the Inertial Guidance Technology Demonstration.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 Request: Funds requested for AD in FY 1989 are the minimum necessary to support adequate developmental test and evaluation of non-nuclear munitions and electronic combat systems. Seek Eagle store certification testing on F-15 and F-16 aircraft will continue to support the tactical forces, as will testing of AMRAAM and the ACM-130. Additional test programs which will be supported in FY 1989 will include the AN/ALQ-161A FOT&E, Low-Cost Seekers, ALR-74 Update, ASPJ Updates, and the Joint Surveillance Target Attack Radar Systems.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06YA, Air Force Flight Test Center (AFFTC)

A. (U) Project Description: The AFFTC, located at Edwards AFB, conducts and supports development and operational

test and evaluation of aircraft and aircraft systems, aerospace research vehicles, unmanned miniature vehicles, cruise missiles and parachute delivery/recovery systems. Air Force parachute and cargo handling systems are also evaluated. Recovery support and engineering evaluation is provided to the Space Shuttle program and other transatmospheric vehicles. AFFTC operates two instrumented ranges: the Edwards Flight Test Range and the Utah Test and Training Range (funded in PE 78019F by the O&M appropriation). Additionally, AFFTC operates the USAF Test Pilot School which annually trains fifty DOD, allied and contractor test pilots, flight test navigators and flight test engineers.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Major weapon systems undergoing testing at Edwards included the B-1B, F-16 and F-15 Multi-Stage Improvement Programs, the Anti-satellite system, Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN), HH-60, B-52 Strategic Systems upgrades, Common Strategic Rotary Launcher, cruise missile evaluations, and technology development efforts such as the X-29 and F-15 Digital Electronic Flight Control System. Additional programs under test included the F-16 Advanced Fighter Technology Integration Program, F-111 Avionics Modernization Program, F-20, and the C-17 parachute and load extraction system development effort. Continuing support was provided for follow-on operational testing of cruise missiles (ALCM and GLCM) and various classified programs.

(2) (U) FY 1988 Program: AFFTC test program workload continues to grow. Testing for 1988 includes continuation of the B-1B, F-16 and F-15 multi-stage improvement program, B-52 strategic system upgrades, cruise missile evaluations, classified programs and technology development efforts on the X-29 and AFTI-16. Planned testing of the MC-130H and F-15E increased significantly. Preparation for testing of the C-17 and ATF Dem/Val accelerated. Planning for space shuttle landings and support of the National Aerospace Plane is underway. The Center is tasked to support some 200 to 250 aircraft fleet fix, modernization and technology development programs. Support of follow-on operational testing of cruise missiles continues.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Forecasted workload continues to increase based on weapon system test schedules. Testing of B-1B, F-16, F-15, F-15E, cruise missile evaluation, MC-130H, X-29, and AFTI-16 will continue. Classified program testing increases significantly. The F-111 avionics modernization program starts up. Shuttle landings build to nine per year. Support of operational testing of cruise missile continues. Preparation for the C-17 and ATF continues. The emergence of avionics intensive weapon systems which are entering the development testing cycle in the next few years presents new challenges, both in terms of ground test and flight test capabilities. Preparations for these systems are underway.

II. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 06UC, 4950th Test Wing (4950 TW)

A. (U) Project Description: The 4950th Test Wing, Aeronautical Systems Division, Wright-Patterson AFB, OH,

performs flight tests of aircraft and airborne systems, supports space vehicle tracking for the Air Force Systems Command's (AFSC) Space Division, other DOD agencies, and the National Aeronautics and Space Administration. The Wing operates AFSC's major flight test aircraft modification facility. Flight tests vary from evaluations of an airborne side-firing cannon to investigation of state-of-the-art airborne laser systems and night attack sensors. The Wing has the capability to conduct full-scale engineering evaluations, airborne instrumentation and data reduction, flight test aircraft modification and technical photo documentation. Staging out of 13 overseas bases, the Advanced Range Instrumentation Aircraft (ARIA) fleet of eight aircraft provide telemetry support for the National Aeronautics and Space Administration and DOD missile launches out of Cape Canaveral, FL, and Vandenberg AFB, CA. Fabrication support is also provided to the Air Force Wright Aeronautical Laboratories.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Continued ARIA and other flight test support for DOD and NASA programs, such as, TRIDENT, Peacekeeper, Inertial Upper Stage, Pershing, TITAN, Poseidon, and cruise missile programs. Continued support for specified DOD flight test programs such as Mark XV Identification Friend or Foe, C-5 Space Cargo Modification, and Advanced Avionics Study. The in-house integrated Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) system was used to conduct engineering design fabrication for flight test aircraft modifications. The second EC-18B/ARIA was flight tested and entered operational service. Another EC-18B/ARIA conversion was be in process.

(2) (U) FY 1988 Program: To continue flight test and ARIA support of DOD and NASA programs. EC-18B ARIA conversion tasks will be completed during FY 1988. The in-house integrated CAD/CAM system will be used to conduct engineering design and fabrication for flight test aircraft modifications.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Program: Continue ARIA and other flight test support for DOD & NASA programs. Continue support in both fabrication/modification and flight test to the Air Force Wright Aeronautical Laboratories and other DOD and government organizations. The ARIA fleet will support a large backlog of space vehicle launches as the Space Shuttle and newly built expendable launch vehicle flight operations ramp up from a modest level in 1988. CAD/CAM capabilities will be improved with the most recent generation of CAD/CAM equipment replacing older, obsolete equipment in an orderly manner that will result in increased engineering design throughput.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

12. (U) COOPERATIVE AGREEMENTS: Not Applicable.

PE: 0605807F

## AMENDED FY 1988/FY BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605808F
DOD Mission Area: 440 - Technical Integration/Studies & Analyses

Title: Development Planning
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 12,637 | 13,093 | 14,431 | Continuing | N/A |
| 3360 | Technical Support | 3,144 | 3,144 | 3,322 | Continuing | N/A |
| 3361 | Mission and System Planning | 9,493 | 9,949 | 11,109 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program (previously titled Advanced Systems Engineering/ Planning) funds two aspects of development planning. The first, Project 3360, is technical support to development planning. The second, Project 3361, is for development planning for new classes of systems, capabilities, and mission area planning. The Air Force has the inherent responsibility to conduct development planning to convert operational requirements into effective weapons systems. This program focuses technology to meet these requirements by performing concept formulation studies, mission analyses, and initial acquisition planning. The program will be used to focus the implementation of PROJECT FORECAST II, the Air Force's comprehensive study to identify new technologies with exceptional promise for improving future warfighting capabilities. The major Air Force operating commands work directly with Air Force Systems Command to identify critical requirements areas to prioritize the use of these funds.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 22,710 | 25,376 | 27,445 | Continuing | N/A |

EXPLANATION: Reduction due to FY 88 Congressional budget cuts and reduction in USAF TOA: Many planning activities/programs were either cancelled, reduced in scope or phased into the future. Fewer new concepts/systems are being looked at to meet projected enemy threats, to find cost-effective alternatives, or to provide the best pre-FSD planning possible.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: Technical support and system and mission planning performed in this program are uniquely related to the overall Air Force RDT&E budget. These activities are used to integrate emerging technologies in the Air Force Science and Technology (S&T) base into candidate system options for acquisition development. As such, development planning is related to the Air Force S&T base as well as the subsequent advanced/engineering development programs which stem from concept feasibility studies and mission area analyses funded in this program.

6. (U) WORK PERFORMED BY: Technical Support (Project 3360) is primarily provided by the Aerospace Corporation, El Segundo CA, and the MITRE Corporation, Bedford MA. Mission and System Planning (Project 3361) is performed by numerous system contractors and analytical service companies.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3360, Technical Support. This project provides technical support for the development planning function. The effort includes scientific and technical support for aeronautical, space, armament, aeromedical, ballistic missile, and command, control, communications, and intelligence ($C^3I$) development planning activities. In FY 89 key efforts will include analysis of space control architecture, artificial intelligence applications, next generation ICBM roadmaps, strategic conventional weapons, highly precise armaments, and mission area plans.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

A. (U) Project Description: This project performs development planning for new classes of systems, capabilities, and mission area planning to convert operational requirements into effective weapon systems. It performs conceptual studies, mission analyses, and initial system acquisition planning to focus technology into those weapon systems. The project will also focus on implementing the initiatives of PROJECT FORECAST II. Key efforts include analysis of high reliability fighters, special operations aircraft, military utility of spaceborne electronic warfare, upgrade of air support operation centers, ICBM test options, cruise missile defense and hypersonic weapons systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Air Force Systems Command conducted planning projects relating to strategic relocatable targets, advanced tactical battle management, advanced transport technology, Military Airlift Command $C^3$ defense, high frequency communications, space-based radar, and advanced strategic aerospace crew systems. The results of these projects were incorporated into the early program design documents of the affected programs.

Program Element: 0605808F | Title: Development Planning
DOD Mission Area: 440 - Technical Integration/Studies & Analyses | Budget Activity: 6 - Defense-Wide Mission Support

(2) (U) FY 1988 Program: This program will contain study of advanced spacecraft concepts, next generation trainer aircraft, MILSATCOM planning, ICBM long-range planning, low-cost precision weapons, aircrew displays, robotic applications, air defense submissiles, hypersonic weapons systems, Soviet military vulnerabilities in space, tactical aircraft launch and recovery systems, USTRANSCOM $C^2$ upgrade, surveillance technology, aerial refueling, and embedded aircraft training systems.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will support the development of mission area plans, and fund studies of high pay-off concepts within the various mission areas. The results of these efforts will form the foundations for the aerospace weapons systems of the mid-to-late 1990s.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Each study effort has its own schedule; they are generally 12-18 month efforts with written products delivered at the conclusion of the project.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

# AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605809F
DOD Mission Area: #451 - Major Range & Test Facilities

Title: Dynamic Coherent Measurement Systems (DYCOMS)
Budget Activity: #6 - Defense Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 0 | 7,471 | 9,191 | 8,338 | 25,000 |
| 4514 | Dynamic Coherent Measurement System (DYCOMS) | 0 | 7,471 | 9,191 | 8,338 | 25,000 |

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This new start test facility will support the increasing interest in applying low observables (LO) technology to aircraft and missile systems. LO technology applications include both special access and traditional design systems. There is currently no facility capable of meeting the requirement to test operational LO airborne platforms. A new facility is required for the acceptance of new LO systems and the maintenance of the LO capability of critical operational assets. The new test facility and its measurement systems must also be fully capable of diagnostic support in order to locate the specific cause of a signature deviation. Government evaluation and acceptance of LO systems must be based upon the results of realistic testing of these systems in their operational configuration, e.g. gear up, control surfaces in use, no pylon, etc., and in the far field. When operational in the DYCOMS LO measurement facility will be the only test site capable of meeting this requirement and supporting the various new generations of LO airborne platforms on a day-to-day basis. Since this represents a USAF capital-plant requirement, no Statement-of-Need or Mission Element Need Statement is required.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 0 | 12,340 | 9,220 | 7,241 | 28,801 |

EXPLANATION: (U) FY88 Congressional Cut was taken.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Operation and Maintenance: Funds | 0 | 0 | 250 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: All systems having signature modifications are involved.

6. (U) WORK PERFORMED BY: Contract to be awarded by Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA., 3rd quarter FY 1988.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 4514, DYCOMS:

A. (U) Project Description: This project develops the test facility and the measurement equipment required for evaluation and acceptance of operational low observables (LO) technology airborne platforms. During the first use of the facility, existing government and industry radar cross sections (RCS) will be examined in "realistic" dynamic free flight to ensure they meet radar cross section specifications. The subsequent evaluation of radar cross section measurements will permit the government to quantify new contractor candidate designs and/or modification to government owned platforms. Without this facility, the government will not be postured to evaluate and/or select among industry designs whose theoretical and laboratory predictions reportedly achieve very low radar cross section.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not Applicable

(2) (U) FY 1988 Program: In early FY 1988, site selection surveys were conducted to locate the best facility location considering funding and technical constraints. Program direction has been issued and the contract should be awarded during the third quarter of the year.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, hardware and software procurement will continue. Site installation and checkout of the DYCOMS measurement equipment will begin.

(4) Program to Completion: For FY 1990 and 1991, the contractor will be primarily involved in measurement system checkout and site testing for final delivery to the government. It is anticipated that these testing requirements will be large due to the necessity to thoroughly understand the RCS performance on the chosen site and its ability to adjust for unique clutter and environmental conditions. Once the site testing is complete, target testing on flying systems will commence. Initial operational capability (IOC) is scheduled for

C. (U) Major Milestones:

| | Dates |
|---|---|
| (1) (U) Contract Award | June 1988 |
| (2) IOC | |

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605863F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: RDT&E Aircraft Support
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 62,000 | 50,000 | 57,826 | Continuing | N/A |
| 2111 | Armament Division | 9,681 | 8,016 | 10,583 | Continuing | N/A |
| 2112 | Air Force Flight Test Center | 34,207 | 27,483 | 28,596 | Continuing | N/A |
| 2114 | 4950th Test Wing | 18,112 | 14,501 | 18,647 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The RDT&E aircraft support program provides resources for maintaining all Air Force Systems Command assigned test and test support coded aircraft which are included as a portion of the Department of Defense Major Range and Test Facility Base. Funds are used to pay for depot level type maintenance such as: Programmed Depot Maintenance (PDM), which is the calendar-based cyclic scheduling of aircraft into the depots for update/inspection; modifications and Time Compliance Technical Orders (TCTO); engine overhauls; exchangeables (recoverable components, such as fuel pumps and electric motors, returned to the depots for repairs); depot provided area assistance; and assorted equipment support that requires DMIF reimbursement. This program currently supports 189 RDT&E aircraft of 24 different types. Many of these aircraft are unique (pre-production, one-of-a-kind, etc.), and the majority are highly modified and uniquely instrumented. The wide variety and small quantity of each type aircraft possessed, the unique/highly modified condition of the test aircraft, the often dedicated status, and the individual work packages (when compounded by the demanding nature of the test environment) result in many challenging management problems which are routinely solved to assure that this large fleet of test aircraft is properly maintained.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 60,000 | 59,034 | 60,862 | Continuing | N/A |

EXPLANATION: (U) Current funding represents FY 1988 Appropriations Act, Department of Defense Fiscal Guidance and changes in the programmed depot maintenance schedules.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The aircraft supported by this program element are either the primary test vehicle or provide test support for Air Force Systems Command (AFSC) research, development, test and evaluation projects. Operations of the aircraft supported by this program is in Test and Evaluation Support, PE0605807F.

6. (U) WORK PERFORMED BY: Depot level maintenance is performed either organically (by the Air Force Logistics Command (AFLC) Air Logistics Centers (ALCs)) or contractually (with the ALCs negotiating/administering the contract). Organically, work is performed at all five AFLC ALCs: Ogden ALC, Hill AFB, UT; Oklahoma City ALC, Tinker AFB, OK; San Antonio ALC, Kelly AFB, TX; Sacramento ALC, McClellan AFB, CA; and Warner Robins ALC, Robins AFB, GA. Contractually, work is being performed by McDonnell Douglas Corp., Tulsa, OK; Boeing Military Airplane Company, Wichita, KS; Lockheed Corp., Marietta, GA; Hayes International Corp., Birmingham, AL; and Vought Corp., Dallas, TX. Other contractors may be used, but this is dependent upon the projected workloads within each AFLC ALC.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2111, Armament Division (AD)

A. (U) Project Description: The Armament Division (AD), Eglin AFB, FL, is the prime United States Air Force organization responsible for nonnuclear munitions armament development. AD accomplishes technology research, engineering development, test and evaluation and initial acquisition of USAF nonnuclear munitions, is the USAF focal point for munitions integration in aeronautical systems, conducts and supports USAF weapons effectiveness testing, electromagnetic warfare testing, electronic surveillance and control testing, and aeronautical systems testing. AD currently has the following types and quantities of test/test support aircraft assigned: A-10A(3); C-130A(1); F-4D(5); F-4E(2); F-15A(1); F-15B(2); F-15C(2); F-15D(2); F-16A(7); F-16B(1); F-16C(4); F-111E(2); UH-1N(2); and T-38A(6). Total aircraft assigned: 40.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: In FY 1987, Programmed Depot Maintenance (PDM) was accomplished on two F-4s. One F-15 was input to the speedline for Time Compliance Technical Order (TCTO) update and painting. TCTOs were accomplished on two UH-1Ns. One UH-1N had an on-condition maintenance inspection accomplished. One UH-1N had a condition inspection accomplished. AD flew 6,828.7 hours which generated corresponding engine overhaul and exchangeable requirements.

(2) (U) FY 1988 Program: Programmed Depot Maintenance (PDM) will be accomplished on one F-4; Speedline and Time Compliance Technical Orders (TCTOs) will be done on one F-15. An inspection will be accomplished on two UH-1Ns. TCTOs will be done on three A-10s, six F-4s, two F-111s, and six T-38s. AD has projected 5,861 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: PDM will be accomplished on one F-4 and two F-111s. Five F-15s are scheduled for Speedline. Two UH-1Ns will have a condition inspection. TCTOs will be done on three A-10s, seven F-4s, two F-111s, and six T-38s. AD has projected 5,299 flying hours which will generate

corresponding engine overhaul and exchangeable requirements.

(4) (U) Program to Completion: This is a continuing program. Continuing support will be required for assigned aircraft. Yearly costs will fluctuate depending upon flying hours, the number of aircraft due PDM, and the types and numbers of modifications being accomplished.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2112, Air Force Flight Test Center (AFFTC)

A. (U) Project Description: The Air Force Flight Test Center (AFFTC), Edwards AFB, CA, conducts and supports tests of aircraft and aircraft systems, aerospace research vehicles, remotely piloted vehicles, cruise missiles and parachute delivery/recovery systems. Support for the Air Force Flight Test Center (AFFTC) aircraft located at the 6514th Test Squadron at Hill AFB, UT, is also funded within project 2112. The 6514th Test Squadron performs tests on remotely piloted vehicle systems and the Ground Launched Cruise Missile. The AFFTC currently has the following types and quantity of test/test support aircraft assigned: A-7D(9), NA-37B(3), B-1(3), B-52G(1), B-52H(2), C-130B(2), C-130H(4), F-4C(6), RF-4C(5), F-4D(3), F-4E(10), F-15A(4), F-15B(1), F-15D(1), F-16A(6), F-16B(7), F-16C(3), F-16D(1), F-111A(1); F-111D(3); F-111E(1), H-1H(6), H-3E(3), H-53C(1), O-2A(5), T-38A(22), T-46(2), and U-6(1). Total aircraft assigned: 116.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Programmed Depot Maintenance (PDM) was done on one C-130B, seven F-4s, and two F-111Ds; Analytical Condition Inspection (ACI) was done on one H-53, two H-1s, and one A-37. Time Compliance Technical Orders (TCTOs) were done on nine A-7Ds, two C-130s, five F-4Cs, two H-1s, and 13 T-38s. Speedline was accomplished on one F-15. Air Force Flight Test Center (AFFTC) flew 22,530.0 hours which generated corresponding engine overhaul and exchangeable requirements.

(2) (U) FY 1988 Program: PDM will be accomplished on three F-4s, and two F-111s. One F-15 will receive Speedline and TCTOs. One A-37 will have ACI done, and two H-1s will have a condition inspection accomplished. TCTOs/modifications will be done on two C-130s, eight F-4s, and 18 T-38s. AFFTC is projecting 26,043 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: PDM will be done on two C-130s, four F-4s, two F-15s, and one F-111. TCTOs/MODs are to be done on four A-7s, two C-130s, 20 F-4s, four F-15s, one HH-1H and two T-38s. A condition inspection will be done on one A-37 and two HH-1Hs. Air Force Flight Test Center (AFFTC) projects 24,858 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(4) (U) Program to Completion: This a continuing program. Continuing support will be required for assigned aircraft. Yearly costs will fluctuate depending upon flying hours, the number of aircraft due PDM, and the types and numbers of modification being accomplished.

C. (U) Major Milestones: Not Applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2114, 4950th Test Wing

A. (U) Project Description: The 4950th Test Wing, Aeronautical Systems Division, Wright-Patterson AFB, OH, performs flight tests of aircraft and airborne systems, supports space vehicle tracking for the Space Division and other DOD and National Aeronautics and Space Administration organizations. The 4950th Test Wing currently has 38 test support aircraft assigned: C-18A(4); EC-18B(3); C-135A(10); C-135E(7); C-141A(4); T-37B(2); T-39A(2); and T-39B(6). Total assigned: 37

Aeronautical Systems Division, Wright-Patterson AFB, OH, is responsible for aircraft leased to contractors, loaned to other Government agencies, or furnished to contractors under Government Furnished Property (GFP) clauses. Depending on the reason for the loan or contractural Government Furnished Property the Air Force can incur liability for the depot level maintenance (DLM) for these aircraft. The Air Force programs and pays for support of these aircraft through the 4950th Test Wing account. Based on current and projected FY 1987/88/89/90 contracts and agreements, AFSC is responsible for DLM costs associated with one NC-131H, one NF-111A, and one NT-33A. Cost for these aircraft are included in teh 4950 test Wing Project.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Programmed Depot Maintenance (PDM) was accomplished on one C-18, on C-130A, one C-135, and one C-141. Wing reskin was done on five C-135s. Modifications/Corrosion control were done on two T-39s. The 4950th Test Wing flew 9,077 hours which generated corresponding engine overhaul and exchangeable requirements.

(2) (U) FY 1988 Program: PDM will be accomplished on three C-135s, and one NF-111A. Analytical Condition Inspection (ACI), corrosion control and life extension modification will be done on two T-39s. TCTOs/mods will be done on two C-135s, three C-141s, and six T-39Bs. The 4950th Test Wing anticipates flying 9,007 hours which will generate corresponding engine overhaul and exchangeable requirements.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Two C-18s, four C-135s, and one C-141 will receive PDM. MODs/TCTOs will be done on two C-18s, two C-135s and one C-141. ACI/corrosion/Life Extension Mod is scheduled on two T-39s. The 4950th Test Wing is projecting 8,804 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(4) (U) Program to Completion: This is a continuing program. Continuing support will be required for assigned aircraft. Yearly costs will fluctuate depending upon flying hours, the number of aircraft due Programmed Depot Maintenance, and the types and numbers of modifications being accomplished.

C. (U) Major Milestones: Not Applicable.

II. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605894F
DOD Mission Area: 472 - Real Property Maintenance

Title: Real Property Maintenance Activity (RPMA)
Budget Activity: 6-Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 124,019 | 74,465 | 81,881 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Real Property Maintenance Activity (RPMA) account provides resources for Air Force Systems Command (AFSC) owned bases for support of utility systems, maintenance engineering services such as crash rescue, fire protection, refuse collection, snow removal, and custodial services. Also funded in this account are facility projects for maintenance, repair, and minor construction work. These projects are required to preserve AF capital investments. It is necessary to sustain direct mission support facilities such as runways and taxiways, and quality of life related facilities such as dining halls, dormitories, and recreational facilities. This account included six AFSC bases in FY 87. The FY 88 decrease reflects the transfer of three bases to the O&M appropriation. The remaining bases are: Edwards AFB, CA; Eglin AFB, FL; and Arnold AFB, TN.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 120,016 | 79,702 | 80,843 | Continuing | N/A |

EXPLANATION: (U) The FY 87 increase reflects a reprogramming action to cover the pay raise, etc.. The FY 88 reduction reflects Congressional action on the appropriation which has reduced our ability to fund facility projects by 27 percent. This reduction comes at a time in which we should be spending millions of dollars for protection of Air Force personnel from exposure to hazardous and toxic substances by complying with federal, state, and local statutory deadlines and requirements. Our facility project baseline had already been cut substantially in FY 87 due to a Congressionally mandated unprogrammic cut. Past funding has not been sufficient to maintain facilities commensurate to Air Force standards. These cuts have caused a further increase in our Backlog of Maintenance and Repair (BMAR) which means that our facilities are continuing to deteriorate past the point of economical repair. The FY 89 increase was due to the decrease of available Western Area Power which causes use of power from Southern California Edison. (.03 cents per kilowatt hour vs .08 per kilowatt hour)

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element: 0605894F Title: Real Property Maintenance Activity (RPMA)
DOD Mission Area: 472 - Real Property Maintenance Budget Activity: 6-Defense-Wide Mission Support

5. (U) RELATED ACTIVITIES: PE 0605807F, Test and Evaluation, provides the mission funds for civilian personnel and utilities at Arnold AFB, TN due to the fact that mission support consumes almost all utilities and personnel efforts.

6. (U) WORK PERFORMED BY: The major contractors in the Real Property Maintenance Activity (RPMA) account are: Powell Sanitation Services, Niceville, FL; Management Technical Services, Camarillo, CA; and Schneider Services, Inc., Pittsburgh, PA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0605894F, Real Property Maintenance Activity

A. (U) Project Description: The Real Property Maintenance Activity (RPMA), account provides funding for three AFSC bases providing Test and Evaluation Support. This account funds items such as custodial services, refuse collection, building maintenance, runway and taxiway repair, environmental studies and projects, and roads and grounds maintenance.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: FY 1987 was the first year the program element was funded, providing support previously funded in PEs 0605806F and 0605807F. This program element funds operation of utility systems; in-house and base-maintenance contracts for maintenance, repair, and minor construction of facilities; leasing of real property; and engineering services such as crash rescue, fire protection, refuse collection, snow removal, and custodial services. This program element also provides resources for environmental studies and projects and contracts for maintenance, repair, and minor construction projects to preserve the Air Force capital investment in mission support facilities (runways, utility systems, dormitories, medical facilities, etc.)

(2) (U) FY 1988 Program: The FY 88 program was reduced to support three AFSC bases vice six in FY 87. This is a continuing program for those three bases from FY 1987.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This is a continuing level of effort for Eglin AFB, FL; Edwards, AFB, CA; and Arnold AFB, TN.

(4) (U) Program to Completion: Continuing level of effort program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

# AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605896F
DOD Mission Area: 473 - Base Operations

TITLE: Base Operation Support
Budget Activity: 6-Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 99,422 | 56,809 | 61,543 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the manpower authorizations and support for base operating activities. These include security services, accounting and finance offices, food service units, supply, administrative services and other base support units. The following bases were funded in this program in FY 1987; Arnold AFS, TN; Brooks AFB, TX; Edwards AFB, CA; Eglin AFB, FL; Hanscom AFB, MA; and Los Angeles AFS, CA. Beginning in FY 88, Brooks, Hanscom and Los Angeles were transferred to the O&M appropriation.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 95,423 | 62,152 | 56,146 | Continuing | N/A |

EXPLANATION: (U) The FY 87 increase reflects a reprogramming action to cover the pay raise, etc.. The FY 88 reduction reflects Congressional action on the appropriation. The FY 89 increase will restore the FY 87 level of effort plus a modest increase for price increases.

4. (U) OTHER APPROPRIATION FUNDS ($ in thousands): Not applicable

5. (U) RELATED ACTIVITIES: PE 0605807F, Test and Evaluation provides the mission funds for the three AFSC bases: Edwards, Eglin and Arnold.

PE: 0605896F

Program Element: 0605896F
DOD Mission Area: 473 - Base Operations

TITLE: Base Operation Support
Budget Activity: 6-Defense-Wide Mission Support

6. (U) WORK PERFORMED BY: Primary contractors performing support in this program include United Management Service, Inc., Toledo, OH; JRW Enterprises, Portsmouth, VA; Better Service Company, Norcross, GA; and Desert Office, Lancaster, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0605896F, Base Operation Support

A. (U) Project Description: The Base Operation Support provides funding for three AFSC bases. Included are such services as transportation, supply, security, and administration.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: This was a new program element in FY 1987, with funds transferred from PEs 0605807F and 0605806F. This program provided operation support funds for six AFSC bases.

(2) (U) FY 1988 Program: This program provides Base Operation Support for three AFSC bases that remain in the RDT&E appropriation. Costs include security, accounting and finance, food service, administrative and other base support costs.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This is a continuing program, providing base operating support for Eglin AFB FL, Edwards AFB CA, and Arnold AFS TN. This program provides for the manpower authorizations and support for base operating activities. These include security services, accounting and finance offices, food service units, supply, administrative services and other base support units.

(4) (U) Program to Completion: Continuing level of effort program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305110F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Satellite Control Facility (SCF)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 75,913 | 95,458 | 100,803 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is the maintenance of a highly reliable national satellite tracking, telemetry and commanding capability to support the development and operation of satellite systems. The Satellite Control Facility is evolving to the Air Force Satellite Control Network (AFSCN). The AFSCN is a global network of instrumentation systems, antennas, communications, and computer systems required to support a growing inventory of increasingly complex space vehicles.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 78,702 | 109,531 | 126,898 | Continuing | N/A |
| Aircraft Procurement | 900 | 0 | 0 | Continuing | N/A |
| Other Procurement | 48,862 | 92,641 | 53,897 | Continuing | N/A |

EXPLANATION: (U) RDT&E - FY 1987 - Decrease is result of congressional reduction of funds. Development of space program mission unique software and modifications to the AFSCN slipped to FY 1988 and outyears.
FY 1988 - Decrease resulted from inflation Congressional reductions and the rephasing of the Advanced Telemetry, Tracking and Commanding program to start in FY 1990.
FY 1989 - Decrease associated with overall Air Force TOA reduction consistent with FY 1988 Congressional reductions and the rephasing of the Advanced Telemetry, Tracking and Commanding program to start in FY 1990.

(U) Other Procurement - FY 1988 - Decrease resulted from undistributed appropriation obligation reduction based on obligation history of Air Force, from inflation and profit policy changes, from congressional reductions, and from deletion of one of the Automated Remote Tracking Station program requirements. Requirement was changed from providing Global Positioning System (GPS)/AFSCN interoperability at three GPS ground antenna locations to providing interoperability at the Diego Garcia GPS location only.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| Aircraft Procurement: | | | | | |
| Funds | 900 | 0 | 0 | Continuing | N/A |
| Quantities | N/A | | | | |

Program Element: 0305110F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Satellite Control Facility
Budget Activity: 6 - Defense-Wide Mission Support

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement: | | | | | |
| Funds | 48,862 | 83,285 | 53,897 | Continuing | N/A |
| Quantities | N/A | | | | |
| Military Construction: | | | | | |
| Funds | 2,600 | 7,500 | 8,800 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: Air Force Satellite Control Network (AFSCN) and non-DCS telecommunications program activities relating to the AFSCN are contained in PE 0305151F (SCF Telecommunications). Real property maintenance activities relating to the AFSCN are contained in PE 0305894F (Real Property Maintenance, AFSC). AFSCN base operating support is contained in PE 0305896F (Base Operating Support, AFSC). The majority of DOD satellite programs rely, to varying degrees on the AFSCN for support. The Defense Meteorological Satellite Program (DMSP), PE 0305160F, and the AFSCN will cooperate to install an interoperable telemetry, tracking and commanding antenna at the Thule Remote Tracking Station, provide a backup control center for DMSP, and close the DMSP Loring AFB Command Readout Station. The Global Positioning System (GPS), PE 0305165F, and the AFSCN will cooperate to assure interoperability between GPS ground antennas a SCF remote tracking stations, and provide a backup to the GPS Master Control Station at the Consolidate Space Test Center (CSTC). The Consolidated Space Operations Center (CSOC), newest element of the AFSCN, PE 0305130F, will provide increased capability and survivability by sharing the control functions of the CSTC.

6. (U) WORK PERFORMED BY: Air Force management of this national capability is under Air Force Systems Command's Space Division, Los Angeles AFB, CA. Principal contractors are: Ford Aerospace Communications Corporation (FACC), Palo Alto, CA, which provides study and development analysis for the remote tracking stations; System Development Corporation Santa Monica, CA, which provides computer system integration; Space Applications Corporation, San Jose, CA, which provides systems engineering integration and test analysis; IBM Corporation, Gaithersburg, MD, which was awarded the development/acquisition contract for the Data Systems Modernization program and Command and Control Sustaining Engineering; and Ford Aerospace Communication Corporation (FACC), Sunnyvale, CA, which was awarded the development/acquisition contract for the Automated Remote Tracking Station program. In addition to RDT&E support, FACC and other contractor provide operations and maintenance support for the network.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0305110F, Satellite Control Facility

A. (U) Project Description: The Air Force Satellite Control Network (including the SCF) consists of seven geographically dispersed tracking stations; a communications satellite calibration site at Camp Parks, CA; and two

control centers (the Consolidated Space Test Center at Onizuka AFB, CA and the Consolidated Space Operations Center, Falcon AFS, CO. The mission of the AFSCN is to provide tracking, real-time telemetry, and commanding of Department of Defense space vehicles operating in a multi-satellite environment. The SCF supports satellites operating with various orbital parameters to accomplish diversified test and operational objectives for the Air Force, Navy, other DOD agencies, the National Aeronautics and Space Administration, and the North Atlantic Treaty Organization. Support commences prior to launch and, in most cases, continues throughout the life of the satellite. A complex instrumentation system consisting of antennas, communications, and data processing equipment provides the ground support capabilities for the many space vehicles. The RDT&E appropriation provides for the development, installation and modification of network components to meet evolving satellite program support requirements. These efforts either correct system deficiencies or allow for increased program support.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Continued efforts to meet evolving satellite program requirements. The most significant portion of FY 1987 RDT&E was the transition of operational satellite programs from the old data systems configuration to the new configuration Data Systems Modernization. The first such transition occurred in March 1986 with the last transition scheduled for 1989. Installation and checkout of equipment in the ARTS Thule, Colorado and Northern Europe stations continued and development, test and evaluation initiated. Communications compatibility testing continued between the AFSCN and the Consolidated Space Operations Center (CSOC).

(2) (U) FY 1988 Program: The ARTS Colorado, Thule and Northern Europe tracking stations will accomplish initial operational capability. Phase II of the ARTS program will be awarded. Communications hardware developed under CSOC will continue to be delivered to the AFSCN. Planning efforts for the Advanced Telemetry, Tracking and Commanding (ATT&C) program will continue resulting in a future competitive contract award. ATT&C will provide an extremely high frequency capability for current and future satellite vehicles. Cost estimates for ARTS and communication efforts are based on ongoing contract cost data and are predominately Category I, comprehensive estimates. Both contracts were competed.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The ARTS program will continue. ARTS will modify/or begin modification of four existing satellite tracking stations and two remote satellite checkout facilities. Cost estimates for ARTS are based on current contract cost data and are predominately Category I, Comprehensive estimates. ATT&C will continue low-level development to support survivable Telemetry, Tracking and Commanding. Cost estimates for ATT&C are Category III, Budgetary estimates.

(4) (U) Program to Completion: This is a continuing program. The AFSCN will continue development of the AFSCN to support new satellite technologies and to provide the highly reliable national satellite tracking, telemetry and commanding capability. ATT&C and ARTS programs will continue.

C. (U) **Major Milestones:**

| Milestones | | | Dates |
|---|---|---|---|
| (1) | (U) | Automated Remote Tracking Station (ARTS) Contract Award | June 1984 |
| (2) | (U) | Consolidated Space Operations Center Communications Contract Award | November 1984 |
| (3) | (U) | Command and Control Sustaining Engineering Contract Award | January 1986 |
| (4) | (U) | ARTS-Thule Tracking Station | February 1988 |
| (5) | (U) | ARTS-Phase II Contract Award | March 1988 |
| (6) | (U) | ARTS-Colorado Tracking Station Initial Operational Capability (IOC) | June 1988 |
| (7) | (U) | ARTS-Northern Europe Tracking Station IOC | September 1988 |
| (8) | (U) | ARTS-Hawaii Tracking Station - A Upgrade IOC | May 1990 |
| (9) | (U) | ARTS-Diego Garcia Internet Station IOC | March 1991 |
| (10) | (U) | ARTS-Vandenberg Tracking Station - A Upgrade IOC | May 1990 |
| (11) | (U) | ARTS-Full Operational Capability | March 1993 |

9. (U) **COOPERATIVE AGREEMENTS:** Not Applicable

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305119F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Space Boosters
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 290,552 | 454,865 | 488,785 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: National security requirements dictate a continuing, highly reliable means of placing critical Department of Defense (DOD) satellites into their required orbits. Assured access to space, directed by the President in the National Security Launch Strategy, will be accomplished through the use of a robust mix of Expendable Launch Vehicles (ELVs) in this program and by the Space Transportation System. The Space Boosters program provides for development, procurement and launch of DOD ELVs, including the Titan IV, Titan 34D, the Delta II (formerly the Medium Launch Vehicle), and the Medium Launch Vehicle (MLV) - II at Cape Canaveral AFS, Florida, and Titan IV, Titan 34D, Titan II Space Launch Vehicle (SLV) and Atlas E at Vandenberg AFB, California. Procurement of 48 Titan IVs, development and modification of 17 Titan II SLVs, development and procurement of up to 24 Delta II's, and planning for up to 11 MLV-II launches are ongoing. This program also provides for engineering support of active launch programs and post-flight assessment of DOD ELVs to maintain their high demonstrated reliability. To continue the "assured access to space strategy" in the future, the program plans to focus technologies leading to development of an Advanced Launch System for the late 1990's, designed to satisfy future Air Force, Strategic Defense Initiative and other national needs for more affordable, responsive, reliable and flexible space transportation.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 274,379 | 246,641 | 15,847 | Continuing | N/A |
| Missile Procurement | 669,267 | 672,312 | 458,006 | Continuing | N/A |

EXPLANATION: (U) A $472.9 million increase in FY 1989 RDT&E funds provides for development of the Centaur upper stage on Titan IV, development of an upgraded Titan IV solid rocket motor through an alternate source, Titan IV launch and production capacity changes necessary to meet adjusted launch rates, and development requirements for the Medium Launch Vehicle II program. The $193.5 million increase in FY 1989 missile procurement funds reflects the net result of a decrease in Delta II costs due to savings in the competitive acquisition and increased requirements for MLV-II procurement, Titan IV solid rocket motor upgrade and Titan IV capacity changes. Prior year changes were due to reprogramming actions associated with Space Launch Recovery: In FY 1987, $16.2 million was added for Centaur Upper Stage development. $208.2 million in FY 1988 RDT&E funds were added to continue Centaur development and for a solid rocket motor alternate source for Titan IV. Procurement funds in 1987 and 1988 totaling $32.3 and $40.7 million, respectively, were necessary for additional procurements of Titan IV boosters and MLV II long lead items.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement | 701,571 | 713,012 | 651,461 | Continuing | N/A |
| Quantities - Titan IV* | 1 | 4 | 3 | | |
| - Titan II SLV ** | 0 | 5 | 0 | | |
| - Delta II | 7 | 7 | 6 | | |
| Medium Launch Vehicle II | 0 | 0 | 2 | | |

* Additional vehicles are funded by a classified program.
** Defense Meteorological Satellite Program production boosters only. Nine more are funded in other program elements.

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Operation & Maintenance | 285,092 | 160,663 | 241,954 | Continuing | N/A |
| Other Procurement | 0 | 2,890 | 2,972 | 0 | 5,862 |
| Military Construction | 0 | 0 | 25,000 | 65,000 | 80,000 |

5. (U) RELATED ACTIVITIES: Major DOD and other space systems that employ the Titan, Delta II, and Atlas boosters include classified space programs, Defense Satellite Communications System (PE 0303110F), the Global Positioning System (PE 0305165F), Defense Meteorological Satellite Program (PE 0305160F), Defense Support Program (PE 0102431F), Milstar (PE 0303603F), Space Test Program (PE 0603402F) and the National Oceanic and Atmospheric Administration polar orbiting meteorological satellites. Titan 34D vehicles launched from Vandenberg AFB are funded by a classified program element, but the operation is managed under this program.

6. (U) WORK PERFORMED BY: The responsible Air Force agency is Air Force Systems Command's Space Division, Los Angeles AFB, CA. Systems Engineering is provided by the Aerospace Corporation, El Segundo, CA. Titan contractors include Martin Marietta Corporation, Denver, CO (core vehicle, Transtage, Titan II, Titan IV); Aerojet Liquid Rocket Company, Sacramento, CA (liquid rocket engines); United Technologies Corporation, Chemical Systems Division, Sunnyvale, CA (Titan 34D and Titan IV solid rocket motors); Hercules Corporation Magna, UT (Titan IV solid rocket motors); General Motors Corporation, Delco Electronics Division, Santa Barbara, CA (guidance); General Dynamics, Convair Division, San Diego, CA (Centaur Upper Stage); Boeing Aerospace Corporation, Seattle, WA (Inertial Upper Stage). Delta II contractors include McDonnell Douglas Astronautics Corportation, Huntington Beach, CA (prime contractor); Rockwell International Corporation, Rocketdyne Division, Canoga Park, CA (stage 1 rocket engines); Aerojet Liquid Rocket Company, Sacramento, CA (stage 2 rocket engines); General Motors Corporation, Delco Electronics Division, Santa Barbara, CA (guidance); Morton Thiokol Corporation, Huntsville, AL and Elkton, MD (solid rocket motors); Hercules Corporation, Magna, UT

(solid rocket motors). Atlas contractors include General Dynamics, Convair Division, San Diego, CA (integration and airframe) and Rockwell International, Rocketdyne Division, Canoga Park, CA (rocket engines). The Medium Launch Vehicle II is beginning a competitive selection process and contractors are undetermined at this point.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0305119F, Space Boosters

A. (U) Project Description: The Department of Defense family of space boosters (Titan, Atlas, Thor, Delta) was developed to provide a versatile capability for meeting national launch requirements. This family of expendable launch vehicles (ELVs) includes decommissioned ballistic missiles (Titan II, Atlas-E and Thor vehicles) upgraded for space launch, as well as boosters designed solely for space launch. The need for a mixed fleet for assured access to space was reinforced by the loss of Space Shuttle launch capability for a minimun of 30 months. To prevent a launch shortfall in the future, the DOD will rely on a robust mixed fleet with ELVs capable of supporting small, medium and large payloads. This program element contains development resources for DOD ELVs, as well as procurement of boosters for Air Force missions. Other users reimburse the program for services provided to non-Air Force programs. Continuing support is provided within the Space Boosters program for active Atlas, Delta, and Titan ELVs, and storage for nine remaining Thors. Specifics on space boosters included in this program are as follows:

(1) (U) Thor - refurbished Thor Intermediate Range Ballistic Missile, programmer guided, liquid rocket engine, single stage. Nine vehicles in storage at Norton AFB, CA. Not an active launch program.

(2) (U) Atlas-E - refurbished Atlas ballistic missile, radio guided, with liquid propellant rocket engine, launched from Vandenberg AFB to low earth orbit; capacity of 1,750 pounds to a 100 mile polar orbit.

(3) (U) Titan 34D/Transtage - liquid rocket engine powered core vehicle, with two strap-on solid rocket motors, Transtage upper stage, and an inertial guidance system. Launched from Cape Canaveral AFS, FL, primarily to geosynchronous orbit with a capacity of 4,100 pounds to geostationary altitude or 33,800 pounds to a 100 mile orbit.

(4) (U) Titan 34D/RCS - radio guidance system version of the Titan 34D without an upper stage, launched from Vandenberg AFB, CA, to low polar earth orbit, with a capacity of 27,600 pounds to 100 miles altitude.

(5) (U) Titan IV - modified version of the Titan 34D, formerly known as the Titan 34D7 Complementary ELV, with longer strap-on solid rocket motors, using a modified Centaur G-prime or Inertial Upper Stage, to be launched from Cape Canaveral AFS, FL, for geosynchronous missions and from Vandenberg AFB, CA, for low polar missions. Capacity of 10,200 pounds to geostationary altitude or 31,100 pounds to low polar earth orbits. With the National Aeronautics and Space Administration's cancellation of the Centaur Upper Stage program on the Space Shuttle, the Titan IV is the

free world's largest capacity space booster, and the only means of providing launch capability above 5000 pounds to geosynchronous orbit. A solid rocket motor upgrade, using an alternate source selected by the Titan IV prime contractor will be available for the vehicle beginning in FY 1991. With this configuration, Titan IV performance is 40,000 pounds to low earth orbit, and 12,700 pounds to geosynchronous altitude.

(6) (U) Titan II Space Launch Vehicle (SLV) - refurbished ICBM, inertial guidance, and liquid rocket engine, to be launched from Vandenberg AFB, CA for small, low polar orbiting payloads. Capacity of 2,600 pounds to 450 miles or 4,200 pounds to a 100 mile altitude polar orbit.

(7) (U) Delta II - Modified version of a Delta launch vehicle, with upgraded strap-on solid rocket motors, and lengthened first stage. The Delta II was selected as the winner of the Air Force's Medium Launch Vehicle competition in January 1987. Delta IIs will be able to place 4220 pounds into circular, inclined orbits of 10,898 miles altitude. The Delta II appears to also offer an internationally-competitive means of satisfying commercial launch requirements by adapting the design to private sector satellites on a commercial basis.

(8) (U) Medium Launch Vehicle (MLV) - II - a competitively procured launch vehicle, now in the process of selection, designed to meet the needs of payloads in the intermediate class, between the capabilities of the Titan IV and Delta II boosters. MLV-II will be used to launch up to 10 Defense Satellite Communications System payloads and one payload in the Space Test Program which were removed from the Shuttle manifest. Performance requirement is 5900 pounds to geosynchronous transfer orbit. The acquisition of MLV-II launch services represents a departure from standard space booster procurement processes, and a move towards procurement of commercial space launch services now being offered to the private sector. The MLV-II acquisition combines many commercial aspects but also retains certain features of a traditional procurement to assure quality and mission success.

(U) In addition to development and procurement of space launch vehicles for the DOD, the Space Boosters program includes post flight analysis, study, modification, redesign and test to correct deficiencies; evaluation and improvement for mission reliability; component reliability improvement to prevent launch vehicle failures; and analysis support and development planning for new missions on these boosters. The operation and maintenance funds in the program provide for refurbishment tasks for the Titan II SLV, launch services for the Atlas E and Titan II SLV at Vandenberg AFB, and launch services for the Titan/Transtage, Titan IV and Delta II at Cape Canaveral AFS. The military construction funds are for launch capacity changes necessary for Titan IV Cape Canaveral dual launch capability and solid rocket motor upgrade.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Titan and the Atlas reliability maintenance, flight assessment, component and subsystem replacement efforts and vendor qualification continued. Titan IV and Titan II SLV production continued. Titan IV production and launch capacity changes were implemented due to delays in the Shuttle recovery program and further reduced availability for DOD missions. The MLV first phase competition was completed in December 1986.

The second phase procurement process was completed with a contract award in January 1987 to McDonnell Douglas Astronautics Corporation for the Delta II. The basic contract is for seven production boosters with contract options for up to thirteen additional for a total of twenty. Two successful Atlas launches were completed including the final launch of the Atlas-H configuration. The final Titan 34B mission was successfully completed, helping to validate part of the Titan 34D launch recovery process.

(2) (U) FY 1988 Program: Titan 34D launches resumed, with two successful launches in October and November 1987. One refurbished Atlas E booster was successfully launched in February 1988. The first Titan IV and Titan II Space Launch Vehicle (SLV) have been delivered to their launch sites for assembly and test. Titan and Atlas reliability maintenance, flight assessment, component and subsystem replacement efforts and vendor qualification will continue. The subsequent Titan 34D launch schedule will depend on delivery of refurbished solid motor components, and at least one more mission is planned for the year. Development of the Titan IV/Inertial Upper Stage capability will be completed and Centaur upper stage development will continue, requiring the bulk of FY 88 RDT&E funds. Acquisition of an upgraded Titan IV solid rocket motor begins for greater reliability, capacity and performance. Other production and launch capacity changes will be made in order to satisfy Titan IV launch requirements for the early 1990's. The Delta II and Titan II SLV will also require RDT&E funding to complete development. Production of the Titan IV and Titan II SLV will continue, with a FY 1988 Initial Launch Capability (ILC) for the Titan II SLV. Planning for a dual launch capability for the Titan IV at Cape Canaveral will begin. Procurement of the Delta II will continue. In FY 1988, two Atlas launches and a minimum of three Titan launches are planned. The Medium Launch Vehicle (MLV) II will conduct a competition to select the best source for required launches.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Titan and Atlas reliability maintenance, flight assessment, component and subsystem replacement efforts and vendor qualification will continue. The final Atlas E and Titan 34D launches are planned during this year. Production of the Titan IV and Delta II will continue, with ILCs for both during the year. Modification of Titan II SLVs will continue. Acquisition of the MLV II will continue. In FY 1989, two Atlas launches, six Delta II launches, two Titan 34D, one Titan II and three Titan IV launches are planned. Cost estimates for the Space Boosters program are based on a large historical data base, contractor estimates and program office cost models. Cost estimating Category II, mature estimates, applies. Contract award prices, with priced options provide a basis for this program's budget. The program is in production for the Titan IV, Delta II and Titan II SLV. Acquisition is underway for the MLV-II. Production has ceased for the other boosters and completed vehicles are awaiting launch.

(4) (U) Program to Completion: This is a continuing program necessary to provide assured access to space for the nation's critical space systems. Titan, Delta II, MLV II and Atlas reliability maintenance, flight assessment, vendor qualification, and component/subsystem replacement efforts will continue until all vehicles have been launched. The program will continue to require funds from other appropriations to support space booster launches, to maintain critical booster support capability, and to phase out certain space booster configurations. Acquisition of Titan IVs will continue, leading to launch of an average of five to seven boosters per year, growing to eight to ten per year in the mid-1990's The Titan II SLV will continue conversions leading to delivery and launch of two to three boosters

per year. The Delta II will continue with procurement necessary for Global Positioning System launch requirements. MLV II will continue with procurement necessary to support Defense Satellite Communications System launch requirements. Launch vehicle support requested by the National Aeronautics and Space Administration and other government agencies may result in slight increases to these DOD launch rates. Joint Air Force - National Aeronautics and Space Administration - Strategic Defense Initiative Office development of an Advanced Launch System will continue with the goals of maturing and demonstrating technology for the next generation of launch vehicles.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | First Titan III launch | | July 1966 |
| (2) | (U) | First converted Atlas F launch | | January 1967 |
| (3) | (U) | 100th Titan III launch | | December 1976 |
| (4) | (U) | Last Thor launch | | June 1980 |
| (5) | (U) | First converted Atlas E launch | | December 1980 |
| (6) | (U) | Thor space launch capability terminated | | May 1981 |
| (7) | (U) | Last Atlas F launch | | June 1981 |
| (8) | (U) | First Titan 34D/Inertial Upper Stage launch at Cape Canaveral AFS, FL | | October 1982 |
| (9) | (U) | First Titan 34D/RGS launch at Vandenberg AFB, CA | | June 1983 |
| (10) | (U) | Titan 34D production terminated | | June 1983 |
| (11) | (U) | First Titan 34D/Transtage launch at Cape Canaveral AFS, FL | | January 1984 |
| (12) | (U) | 300th Titan family booster launch | | August 1984 |
| (13) | (U) | Initiate Titan IV acquisition | | February 1985 |
| (14) | (U) | Initiate Titan II Space Launch Vehicle acquisition | | January 1986 |
| (15) | (U) | Last scheduled Titan 34D launch from Vandenberg AFB (VAFB), CA | *(FY 1987) | FY 1989 |
| (16) | (U) | Last scheduled Titan 34D launch from Cape Canaveral AFS, FL | *(FY 1988) | FY 1989 |
| (17) | (U) | Titan II Space Launch Vehicle initial launch capability (ILC) at VAFB | *(April 1988) | July 1988 |
| (18) | (U) | Titan IV ILC at Cape Canaveral AFS, FL | | October 1988 |
| (19) | (U) | Delta II ILC at Cape Canaveral AFS, FL | | October 1988 |
| (20) | (U) | Titan IV ILC at Vandenberg AFB, CA | *(January 1989) | January 1990 |
| (21) | (U) | Last Atlas E launch from Vandenberg AFB, CA | | FY 1989 |
| (22) | (U) | Medium Launch Vehicle II Initial Launch Capability | | FY 1991 |

* Date presented in FY 1988/FY 1989 Descriptive Summary

(U) **Explanation of Milestone Changes**

(15) (U) Titan 34D launch schedule slipped due to recovery progr m and hardware availability
(16) (U) Titan 34D launch schedule slipped due to recovery program and hardware availability
(17) (U) Titan II launch capability moved 3 months to accommodate guidance system changes
(20) (U) Titan IV ILC moved due to launch pad availability affected by Titan 34D schedule
(22) (U) Medium Launch Vehicle II added to meet DOD launch requirements impacted by Shuttle availability

9. (U) **COOPERATIVE AGREEMENTS:** None

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305130F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Consolidated Space Operations Center (CSOC)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 68,559 | 39,864 | 44,085 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Consolidated Space Operations Center (CSOC) program element (PE) funds the development, acquisition, and continuing operation of a major facility for the planning, coordination and execution of Department of Defense (DOD) space operations. The PE funds land acquisition, utilities development and construction of four major structures for operations, operations support, power production, engineering and administration. CSOC, located at Falcon Air Force Station (FAFS), CO, will function as a major operational control center within the Air Force Satellite Control Network (AFSCN), a worldwide configuration of space-ground link resources consisting of Remote Tracking Stations (RTSs) and communications and control centers. CSOC is comprised of a Satellite Operations Complex (SOC) as its main functional element plus four additional segments that will collectively provide the required support capabilities. These support segments are a Communications Segment (CS), a Facilities Segment (FS), a Network Control Segment (NCS) and a Support Segment (SS). The SOC will plan and execute control of operational DOD satellites. The CS consists of terrestrial and satellite communications circuits and equipment required for internal CSOC operations and external mission-related interfaces. The FS provides buildings, roads, utilities, parking and other real property-type items for the CSOC and other on-site operations. The NCS schedules, coordinates and controls the resources of the AFSCN and is interoperable with a similar activity at the Consolidated Space Test Center (CSTC), Sunnyvale, CA. The SS includes the Security Control Subsystem, a Weather Support Unit, the Timing Subsystem, the Operations Command Center, a Technical Data Center and a Training Element. The CSOC will correct vulnerability, electronic privacy and capacity deficiencies in the existing satellite control architecture. CSTC poses a potential single point failure in the existing common user satellite control network. CSTC is vulnerable to hostile man-made and local environmental threats. The civil and industrial communities have closely encircled the CSTC, impairing physical security, electronic privacy and facility expansion. The CSOC program corrects these deficiencies primarily by siting its facility in an undeveloped locale of an environmentally stable region, geographically separated from the CSTC.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 71,173 | 50,020 | 39,126 | 69,613 | 485,955 |
| Other Procurement | 71,094 | 9,332 | 8,802 | 14,722 | 354,583 |

EXPLANATION: (U) RDT&E: FY 1988 funding decrease reflects a major Congressional reduction ($10 million) which in conjunction with system performance problems contributed to a program schedule slip. Additional FY 1989 funds ($5 million) are for increased integration and test support during system test and IOT&E phases to maintain current

schedule. Other Procurement: FY 1987 through FY 1989 funding changes resulted from a combination of Gramm-Rudman-Hollings reductions, pricing updates, projected actual repricings, FY 1987 and FY 1988 Congressional reductions and spares adjustments. Overall reductions add risk to current activation schedule.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Estimate | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Other Procurement | | | | | |
| Funds | 69,040 | 6,324 | 8,021 | Continuing | N/A |
| Quantities | | Not Applicable | | | |

5. (U) RELATED ACTIVITIES: Program management is funded through PE 0702806F, Acquisition and Command Support. PE 0303112F, AF Communications, and 0303126F, Long Haul Communications, provide administrative and operational communications support. PE 0305110F, Satellite Control Facility, funds the Colorado Tracking Station, collocated at Falcon AF Station and the Data System Modernization project which develops the Consolidated Space Operations Center's (CSOC) satellite control equipment. Air Training Command participation in the CSOC operations training program is supported by part of PEs 0804731F, General Skill Training; 0804772F, Training Development; and 0805796F, Base Operations (Training). Base operations support is funded by PE 0102496F, Base Operations-AFSPACECOM. Logistics support is funded by PE 0701112F, Inventory Control Point Operations. Utilities and facilities maintenance are included in PE 0102894F, Real Property Maintenance. PE 0305165F funds the Global Positioning System master control station collocated at Falcon AFS. PE 0303603F funds development, Initial Operational Test and Evaluation and operation of the Milstar Master Control Station also collocated at Falcon AFS. Funding and manning in PEs 0702891F, Commissary/ Retail Sales, and 0807792F, Station Hospitals/Medical Clinics, have been increased to service CSOC personnel. There are also several Collocated Program Elements (CPEs) that relate to the CSOC mission and are located at FAFS. The CPEs use CSOC's support capabilities, but are not a direct part of the CSOC acquisition. These CPEs include the Colorado Tracking Station, the Global Positioning System master control station, the Milstar master control station, a Defense Satellite Communications System communications terminal and the Strategic Defense Initiative's Interim National Test Facility.

6. (U) WORK PERFORMED BY: The CSOC System Program Office (SPO) is located at the Air Force Systems Command's Space Division, Los Angeles, CA. The Aerospace Corp, El Segundo, CA, provides the SPO with system engineering services and TRW, Inc., Redondo Beach, CA, provides CSOC system integration services. The satellite control systems are being developed and produced by IBM at their Gaithersburg, MD, facilities. The communications system is being developed by Space Communications Company, a division of CONTEL, Gaithersburg, MD. The facilities design work was completed by Holmes & Narver, Orange, CA. The Army Corps of Engineers, Omaha, NE, managed the construction of the CSOC facilities. Schmidt-Tiago, Colorado Springs, CO, completed site preparation work, and Bechtel National Inc., San Francisco, CA, constructed the CSOC facilities. Lockheed Space and Missile Company, Sunnyvale, CA and INFOTEC Corp, Costa Mesa, CA were awarded contracts to provide positional training for CSOC operations personnel.

Program Element: 0305130F
Mission Area: 410 - Space Launch and Orbital Support

Title: Consolidated Space Operations Center (CSOC)
Budget Activity: 6 - Defense-Wide Mission Support

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0305130F, Consolidated Space Operations Center (CSOC)

A. (U) Project Description: Development and activation of CSOC is occurring in several phases. Each phase will result in an increment of added operational capability. CSOC facilities were available for occupancy in October 1985. Utilities and communications are operational and supporting the Global Positioning System Master Control Station, CSOC's first operational capability. The first and second satellite Mission Control Centers (MCCs) and their associated communications systems comprise the Satellite Operations Complex (SOC) and are projected to be fully operational in FY 1989. The CSOC Network Control Segment and its assigned people will be fully functional and certified for Air Force Satellite Control Network (AFSCN) range control, scheduling operations and scheduling interoperability with the Air Force Consolidated Space Test Center (CSTC) in FY 1989. Development of the Shuttle Operations and Planning Complex (SOPC) in the CSOC has been terminated.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Facilities work was completed. Installation, integration and test of command and control software and associated communications systems for the first MCC (MCC-1) continued throughout the year. Successful contacts with on-orbit Global Positioning System (GPS) satellites were routinely performed during testing. These activities will support an initial operational capability (IOC) for control of GPS satellites in early FY 1989. Installation, integration and test of command and control software and associated communications systems for the second MCC (MCC-2) began in FY 1987 to support an IOC in mid-FY 1989. Training of operations personnel continued with positional qualification through team-level rehearsals. First cadre of satellite mission controllers completed initial training in June 1987.

(2) (U) FY 1988 Program: Operational testing of the first CSOC Mission Control Center (MCC-1) will continue, supporting the scheduled FY 1989 IOC date. These tests, using Data System Modernization hardware and software, will demonstrate the MCC's ability to track, monitor and command the Global Positioning System (GPS) satellite constellation. Primary control authority for the GPS constellation will transition from Onizuka AFB, CA to MCC-1 at CSOC, followed by operational turnover to Air Force Space Command in early FY 1989. A limited support capability for the Defense Meteorological Satellite Program (DMSP) and the Defense Support Program (DSP) satellites will be added to MCC-1. Operational testing involving contacts with on-orbit DSP and DMSP satellites will be performed to support an IOC of this added MCC-1 capability in late FY 1989. Development of software required for AFSCN range control and scheduling will be completed and operational testing will begin. The CSOC Network Control Segment and its assigned personnel will become fully operational and certified for AFSCN range control, scheduling and scheduling interoperability with the Consolidated Space Test Center (CSTC) at Onizuka AFB, CA. Due to the maturity of the FY 1988 planned program, the cost estimates are predominantly Category I, Comprehensive estimates.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Extensive testing of all elements of the first Mission Control Center (MCC-1), the second Mission Control Center (MCC-2) and the fully activated communications system will occur in FY 1989. These tests will demonstrate CSOC's ability to track, monitor and command Global Positioning System (GPS), Defense Support Program (DSP) and Defense Meteorological Satellite Program (DMSP) satellites in MCC-1 and military communications satellites such as the Defense Satellite Communications System (DSCS) satellites, the Fleet Satellite Communications System (FLTSATCOM) satellites and the North Atlantic Treaty Organization (NATO) II/III satellites in MCC-2 with all required communication networks. Operational testing of both MCCs will culminate in turnover of operational capability to Air Force Space Command. The CSOC communications system will be completed by addition of direct duplex high data rate communications between CSOC and elements of the Air Force Satellite Control Network (AFSCN), completion of the communications nets for the Operations Command Center, installation and checkout of the Network Control Segment and the Timing Subsystem, and completed communications for CSOC's Weather Support Unit. Sustaining Satellite Operations Complex (SOC) training continues. Due to the maturity of the FY 1989 planned program involving primarily operational testing and integration of communications systems, the cost estimates are Category I, Comprehensive estimates, and Category II, Mature estimates.

(4) (U) Program to Completion: This is a continuing program to support operational DOD satellites. Acquisition, activation, system integration and test of technical systems in support of operations will continue through the Five Year Defense Plan (FYDP). After the turnover of operational responsibility for the MCCs to Air Force Space Command, emphasis of RDT&E activities shifts to activation and checkout of the full communications system and total integration into the AFSCN. Basic CSOC program development will be completed in FY 1990 with declaration of Full Operational Capability (FOC) and total transfer of operations responsibility to Air Force Space Command. The RDT&E portion of this program element will extend through FY 1994 for sustaining engineering support to satellite operations.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Mission Element Need Statements Validated | | September 1979 |
| (2) (U) Site Selection Announcement | | March 1981 |
| (3) (U) Construction Start | | May 1983 |
| (4) (U) Facility Occupancy | | October 1985 |
| (5) (U) Global Positioning System Master Control Station Operational | | January 1986 |
| (6) (U) First Cadre of Satellite Mission Controllers Complete Initial Training | | June 1987 |
| (7) (U) First Satellite Mission Control Center Operational | *(Sept 1987) | 1st Quarter FY 1989 |
| (8) (U) Second Satellite Mission Control Center Operational | *(May 1988) | 3rd Quarter FY 1989 |
| (9) (U) CSOC Full Operational Capability (FOC) | | 4th Quarter FY 1990 |

*Date presented in FY 1988/FY 1989 Descriptive Summary

(U) Explanation of Milestone Changes:

(7), (8) (U) Operational dates for CSOC's Mission Control Centers (MCCs) slipped due to program rephase dictated by fiscal constraints and technical problems in the command and control software and in the communications system.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305160F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Defense Meteorological Satellite Program (DMSP)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 59,556 | 42,675 | 53,364 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Operational commanders in all Services require timely, quality weather information to effectively employ weapon systems and protect DOD resources. The Defense Meteorological Satellite Program is the DOD's most important single source of weather data. Program requirements were revalidated by the Joint Chiefs of Staff in August 1986. The operational Commanders-in-Chief continue to strongly state their requirement for an operational DMSP in their semiannual situation reports. This Program Element provides satellites and sensors, command and control, Air Force strategic data processing and fixed and mobile tactical data receipt and processing terminals, and operations and maintenance.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 61,169 | 56,181 | 68,539 | Continuing | N/A |
| Missile Procurement | 18,872 | 97,446 | 212,113 | Continuing | N/A |
| Other Procurement | 3,377 | 10,374 | 22,954 | Continuing | N/A |

EXPLANATION: (U) RDT&E funds were reduced in FY 1987 due to higher Air Force priorities and in FY 1988 by Congress. The FY 1989 request was reduced due to the deferral of the development of a laser radar global wind sensor and a delay in the start of Block 6 advance development. This Block 6 delay was made possible by the outstanding on-orbit success of the first two Block 5D-2 satellites (F-6 and F-7) which each exceeded their expected on-orbit mean mission durations by over a year. And also by the successful Atlas-E launch of their replenishment satellites F-8 in June 1987 and F-9 in February 1988. Missile procurement funds were reduced in FY 1987 due to higher Air Force priorities. In FY 1988 Congress did not support the multiyear procurement of Block 5D-3 primary cloud imaging sensors. In FY 1989 the Block 5D-3 S-17 spacecraft was slipped to FY 1990 again due to the outstanding Block 5D-2 on-orbit and launch performance. Other procurement funds were increased in FY 1987 to complete critical Command, Control, and Communication ($C^3$) Segment upgrades, reduced in FY 1988 based on revised estimates of spares requirements, and reduced in FY 1989 due to reduced $C^3$ requirements.

Program Element: 0305160F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Defense Meteorological Satellite Program (DMSP)
Budget: 6 - Defense Wide Mission Support

4. (U) **OTHER APPROPRIATION FUNDS: ($ in thousands):**

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Funds | 17,879 | 71,646 | 159,313 | Continuing | N/A |
| Quanitities | 0 | 0 | 1 | | |
| Other Procurement: | | | | | |
| Funds | 6,436 | 9,311 | 17,079 | Continuing | N/A |
| Quantities | Not Applicable | | | | |

5. (U) **RELATED ACTIVITIES:** The Defense Meteorological Satellite Program is a Joint-Service program in accordance with the Joint-Service Memorandum of Agreement on the Management and Operation of DMSP. Based on the successful operation of an experimental receiving and data processing terminal aboard the USS Constellation, the Navy has equipped eight aircraft carriers to receive DMSP data and is also operating shore based terminals. Seventy-two SMQ-11 shipboard and shore terminals are under development by the Navy. The Navy, under PE 0305160N, is jointly funding microwave imaging sensor procurement to better meet oceanographic requirements. Through the DMSP program office, the Marine Corps has procured eight of the new Air Force developed Mark IV transportable terminals, with four additional planned. Navy personnel are integrated into the program office to insure compatibility between the Air Force developed satellites and the receiving and data processing equipment of the Navy and Marine Corps. A Special Assistant for Air Force/Army represents these Service users within the program office. Close coordination is also maintained with the civilian polar-orbiting weather satellite program operated by the Department of Commerce (DOC). The two systems have different primary missions and different primary sensors. Cloud imagery is the primary DOD need, while vertical temperature and moisture soundings are the primary DOC needs. Interchange of technology and joint studies have been continuous, with special emphasis on avoiding duplication of effort. Pursuant to a study directed by the Office of Management and Budget, DOC was directed in January 1974 to adopt the DOD spacecraft design, the Block 5D, as the basic spacecraft bus for the civil system. Atlas-E and Titan II launch services for the DMSP are provided by the Space Boosters Program (PE 0305119F). Leased communications are provided for the DMSP Command, Control and Communications Segment by DMSP Communications (PE 0305162F). The DMSP and the Automated Remote Tracking Station (ARTS) program (PE 0305110F) are cooperating to install an interoperable telemetry, tracking, and control antenna at the Thule Air Base, Greenland Remote Tracking Station. This initiative, in conjunction with other command and control upgrades, will allow closure of the dedicated DMSP Command Readout Station at Loring AFB ME in early FY 1989. DMSP sensor demonstrations are flown in conjunction with the Space Test Program (PE 0603402F). Strategic data processing upgrades such as the Satellite Data Support System (SDSS) at Air Force Global Weather Central are jointly funded with Air Weather Service (PE 0305111F). Both the Army and Navy are jointly funding with the Air Force the Block 6 competitive concept studies which will define the the defense environmental satellite system of the early 2000s.

6. (U) **WORK PERFORMED BY:** Development and procurement are managed by Space Division, Los Angeles AFB CA. The Air

Force Geophysics Laboratory, Hanscom AFB, Bedford MA and the Naval Research Laboratory, Washington DC, contribute to DMSP mission sensor development, calibration, and validation. The Aerospace Corporation, El Segundo CA, provides General Systems Engineering and Integration Support. Contractors include: General Electric/RCA Astro Space Division, East Windsor NJ (spacecraft, satellite integration and Block 6 studies); Westinghouse Electric Corporation, Baltimore, MD (primary cloud imaging sensor); Hughes Aircraft Company, Los Angeles CA (mission sensors and Block 6 studies); Aerojet Electro-systems, Azuza CA (mission sensors); Harris Corporation, Melbourne FL (ground command and control and data processing); General Electric Americom, Princeton NJ (commercial communications satellite data relay under PE 35162F); Integral Systems Inc., Lanham MD (independent verification and validation of satellite flight software); Ford Aerospace, Palo Alto CA and Lockheed Missiles & Space Company, Sunnyvale CA (Block 6 studies).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 0305160F, Defense Meteorological Satellite Program:

A. (U) Project Description: The DMSP is a Joint-Service program which supports all military Services. The DMSP provides visible and infrared cloud cover data and other meteorological, oceanographic, and solar-geophysical information. These data are required over the entire surface of the earth in support of strategic and tactical missions. At least two satellites are required in sun synchronous polar orbit at all times, each giving coverage of the whole earth every 12 hours. (Sun synchronous means that the satellite crosses the equator, going north, at the same local sun time on each of its 14 orbits/day.) Typically, the DMSP has one satellite that crosses the equator in the early morning and a second satellite that crosses the equator in late morning. This Program Element provides the satellites and sensors; ground command and control facilities and personnel; Air Force fixed and mobile tactical data receipt and processing terminals; and operations and maintenance. The Air Force procured new mobile tactical terminals (Mark IVs) in FY 1978-1986. The remaining seven 1960s era Mark IIA and III fixed site terminals will be extensively modified and upgraded to Mark IV standards. A capability to process non-imagery mission sensor data will be incorporated and retrofitted into the mobile terminals. In FY 1986, Congress approved the continued use of expendable launch vehicles (ELV) for DMSP Block 5D satellites. The directed ELV is the Titan II Intercontinental Ballistic Missile now removed from operational use. The modification and use of Titan II as a space launch vehicle will cover DMSP mission replenishment needs at a large cost savings and with great operational efficiency through the 1990s. DMSP Block 5D satellites will launch on Atlas-E launch vehicles through FY 1989 and transition to Titan II in FY 1990. Through the 1990s DMSP will gradually transition from Block 5D-3 procurement to increasing effort on Block 6 development.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: The FY 1987 DMSP program continued efforts begun in prior years. The prototype Titan II booster refurbishment for DMSP continued. The first Block 5D-3 satellite (S-15) completed its Critical Design Review (CDR) and began subsystem level test in preparation for sensor integration and the start of system level tests in FY 1989. Block 5D-3 differences over the highly successful Block 5D-2s are evolutionary,

including larger batteries for longer on-orbit life, improved survivability and autonomous operation, and the establishment of a Titan II launch vehicle baseline. These changes are similar to previous ones made to the old Block 5D-1 Thor launched satellites. The multiyear procurement of the Block 5D-2 S11-S14 satellites begun in FY 1983 continued, along with the associated sensor integration and testing. Procurement of the command and control hardware for the hardened satellite operations center near Fairchild AFB WA continued and integration began. The shared Thule command and control antenna effort continued. Upgrades continued to the strategic data processing and handling capability at Air Force Global Weather Central to improve support to Air Force and Army operational forces.

(2) (U) FY 1988 Program: The FY 1988 effort was a continuation of efforts begun in prior years. The first Block 5D-3 satellite continued in subsystem level testing with laser survivability efforts continuing. Command and control system upgrades also continued with the hardened satellite operations center nearing its FY 1989 completion. The shared Thule command and control antenna facility was completed and the DMSP Loring AFB ME Command Readout Station will be closed in early FY 1989. The Air Force Mark IV mobile tactical terminal production was completed in in early FY 1988. In FY 1988, DMSP procured two primary cloud imaging sensors for the S-16 and S-17 spacecraft. In FY 1988, DMSP awarded four competitive concept study contracts for the DMSP Block 6 satellite system which will be needed to meet future on-orbit requirements after Block 5D-3. Objectives include lowering system life cycle cost through a competitive design to cost approach, upgrading early 1970s Block 5D technology, and exploring cost effective opportunities for satisfying military requirements for increased survivability, interoperability, and remote sensing.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The DMSP FY 1989 RDT&E effort is the minimum essential program to complete on-going upgrades and provide essential support to a high priority, stable operational space program. The FY 1989 effort will focus on the completion of the first Block 5D-3 satellite (S-15) and delivery of the first Titan II launch vehicle for DMSP, award of a competitive contract for the Mark IVB tactical terminal upgrade program, continuation of the Block 6 competitive concept studies, on-orbit calibration and validation of Block 5D-2 mission sensors, completion of command and control and strategic data processing systems upgrades, and minimum essential continuing contractor support. In FY 1989, DMSP will integrate the new microwave water vapor sounder on a Block 5D-2 satellite, and the first Block 5D-3 satellite (S-15) will complete subsystem level testing and start system level integration and testing with all sensors. Command and control system upgrades will near completion with the Fairchild Satellite Operations Center completing Air Force acceptance. Upgrades to the remaining seven older 1960s era fixed site Mark IIA and III tactical data receipt and processing terminals will begin to bring them up to the standards of the newer mobile Mark IVs. In addition, to complement satellite imagery, a capability to process available microwave imagery, temperature, and water vapor data will be incorporated into these terminals. These data are critically needed by tactical forces for operational mission support, especially employment of precision guided munitions. This capability will be retrofitted into the mobile terminals along with a capability to process US and foreign civil geosynchronous weather satellite data, as a timely supplement to the higher resolution DMSP data. All mobile terminals will also be hardened against nuclear effects. In FY 1989, DMSP will initiate its second multiyear procurement and procure one Block 5D-3 spacecraft (S-16) with expanded advanced material buy for economic order quantities, funded to termination liability, for the S-17 spacecraft which will follow in FY 1990 and the S18-S20 spacecraft which will follow in FY 1991. While Congress did not approve the multiyear procurement of DMSP primary cloud imaging sensors beginning in FY 1988, the DOD feels strongly that multiyear

procurement is the most efficient and cost effective approach for stable, high priority operational satellite programs like DMSP. The projected savings for a multiyear procurement of the five Block 5D-3 spacecraft (S16-S20) in FY 1989-1991 is $72 million, an 18% savings or effectively five spacecraft for the price of four. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. The last comprehensive reviews of cost estimates were completed in July 1987 and February 1988 (multiyear procurement).

(4) (U) Program to Completion: This is a continuing program. The program will continue procurement of Titan II-compatible spacecraft allowing a transition to Titan II in FY 1990. Upgrades to the sensor payload will continue to take advantage of developing technology without impact to the stable spacecraft design, allowing the system to better meet the validated operational requirements of the special strategic mission and the Joint Chiefs of Staff. Multiyear procurement of replenishment spacecraft will continue. In FY 1991, the Air Force will continue the Block 6 development effort by awarding two competitive Advance Development/Demonstration and Validation contracts. One contractor will be selected to proceed with Full Scale Development and building two prototypes (S21-S22) in FY 1994.

C. (U) Major Milestones:

| | | Milestones | | Dates |
|---|---|---|---|---|
| (1) | (U) | Award of Block 5D-2 Multiyear Procurement Contract (S11-S14) | | 8 September 1983 |
| (2) | (U) | First Block 5D-3 Titan II Qualified Spacecraft (S-15) Contract | | FY 1986-90 |
| (3) | (U) | Successful Launch of the Fourth Block 5D-2 Satellite (F-9) | | 3 February 1988 |
| (4) | (U) | Shared Antenna Facility at Thule AB Greenland Operational | | FY 1988 |
| (5) | (U) | Block 6 Concept Studies | *(FY 1988-89) | FY 1988-90 |
| (6) | (U) | Award of Block 5D-3 Multi-year Procurement Contract (S16-S20) | | FY 1989 |
| (7) | (U) | Close Existing Loring AFB Antenna Facility | *(FY 1988) | FY 1989 |
| (8) | (U) | Command/Control Facility at Fairchild AFB Operational | | FY 1989 |
| (9) | (U) | Titan II Launch Capability for DMSP | | FY 1990 |
| (10) | (U) | Block 6 Advanced Development | *(FY 1990-91) | FY 1991-93 |
| (11) | (U) | Block 6 Full Scale Engineering Development | *(FY 1991-94) | FY 1994-96 |
| (12) | (U) | Deliver Block 6 Prototype Satellite (S-21) | *(FY 1998) | FY 2002 |
| * | (U) | Date presented in FY 1988/FY 1989 Descriptive Summary | | |

(U) Explanation of Milestone Changes

(5, 10, 11, 12) (U) Block 6 need date and all milestones extended because of the outstanding Block 5D-2 on-orbit performance and the successful Atlas-E launches of F-8 in June 1987 and F-9 in February 1988.

(7) (U) Loring closing delayed to provide overlap with delayed Thule antenna checkout.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0305171F — Title: Space Shuttle Operations
DOD Mission Area: 410 - Space Launch & Orbital Support — Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| | TOTAL FOR PROGRAM ELEMENT | 90,918 | 51,205 | 58,715 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Department of Defense places heavy reliance on its space assets to accomplish its strategic, and tactical airlift missions. Requirements include such capabilities as communications, navigation, weather, early warning, and surveillance. An access to space is required for these space assets to perform their respective missions. The Space Shuttle Operations program provides the Space Transportation System resources needed to transport Air Force space payloads to their mission orbits. Main program objectives are to provide consolidated management, programming, and execution of operational Air Force Space Shuttle, Inertial Upper Stage (IUS), and Payload Assist Module-Delta Class II (PAM-D II) upper stage programs and the Vandenberg Shuttle Launch and Landing Site (VLS). This includes activities that are common both to research and development programs and to operational satellite programs, as well as payload integration and flight operations planning. The program also funds the development and acquisition of upper stages to support launches in the early 1990s. DOD use of the Space Shuttle is paid for in the form of an Orbiter Flight Charge reimbursement made to NASA one year prior to the scheduled launch date. Work performed in support of research and development satellite programs is funded in the RDT&E appropriation. While work performed in support of operational satellite programs is funded in the Operations and Maintenance appropriation.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 103,837 | 86,554 | 156,070 | Continuing | N/A |
| Missile Procurement | 37,769 | 108,051 | 83,887 | Continuing | N/A |

EXPLANATION: (U) The FY 1987 - FY 1989 RDT&E reductions are due to termination of Airborne Support Equipment developments and the cancellation of the 10,000 pound class upper stage development. The Missile Procurement requests decreased as a result of the termination of the PAM-D II upper stage multiyear contract for Global Positioning System (GPS) satellites 17-28 and the IUS procurement planned for Defense Support Program satellites 22 through 25.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Missile Procurement: | | | | | |
| Funds | 12,965 | 108,451 | 23,620 | Continuing | N/A |
| Quantities | | | | | |
| Inertial Upper Stage | 0 | 0 | 0 | | |
| Payload Assist Module-Delta Class II | 7 | 0 | 0 | | |
| Other Procurement: | | | | | |
| Funds | 375 | 0 | 0 | | N/A |
| Quantities | Not Applicable | | | | |

5. (U) RELATED ACTIVITIES: The research and development satellite program supported is the Space Test Program (PE 0603402F). The operational satellite programs supported are the the Defense Support Program (0102431F), and Navstar Global Positioning System (PE 0305165F). The Air Force operational programs will provide resources for nonrecurring integration and program-unique launch hardware and/or services. Space Shuttle Operations will provide these integrations and services for Air Force research and development programs. The resources for support to other Department of Defense programs are included in the appropriate Special Activity and Department of the Navy Program Elements.

6. (U) WORK PERFORMED BY: The responsible Air Force agency is the Air Force Systems Command's Space Division, Los Angeles, CA. Systems engineering is provided by the Aerospace Corporation, El Segundo, CA. The Inertial Upper Stage (IUS) and spacecraft integration contractor is the Boeing Aerospace Company, Seattle, WA. The Payload Assist Module (PAM-D) II contractor is the McDonnell-Douglas Astronautics Company, Huntington Beach, CA. The Mission Integration Support Contractor is Martin Marietta Corporation, Denver, CO. The Vandenberg Shuttle Processing Contractor (SPC) is the Lockheed Space Operations Company, Titusville, FL. The National Aeronautics and Space Administration is the Space Transportation System manager and operates the national Space Shuttle eastern launch site at Kennedy Space Center, FL, and the Mission Control Center at Johnson Space Center, TX.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989

(U) Project: 35171F - Space Shuttle Operations

A. (U) Program Description: This program provides the Shuttle operations resources that are common to the Department of the Air Force research and development and operational satellite programs. This support includes procurement of the Inertial Upper Stage (IUS) and Payload Assist Module-Delta Class II (PAM-D II).upper stages and their associated launch services; payment of Orbiter Flight Charge reimbursements to the National Aeronautics and Space Administration; maintenance and operation of mission control capabilities; implementation and compliance with DOD Shuttle security requirements; management and training for the Manned Spaceflight Engineer (MSE) program; recurring payload integration (operational missions); non-recurring payload integration (research and development missions); and preservation of the national Space Shuttle Launch and Landing Site (VLS) at Vandenberg AFB, CA.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: DOD and NASA agreed on a Shuttle manifest which satisfies both national security requirements and NASA scientifc missions. No Orbiter flight charge will be paid to NASA since only one NASA mission is scheduled to be flown in FY 1988. In additon, no Shuttle flight charges will be paid to NASA for the first nine DOD missions due to payments made in prior years for which no flight was provided. The production of three additional IUS vehicles that began under the second production contract continued. Eight DSCS satellites were offloaded from the Shuttle manifest to allow greater flexibility in scheduling the remaining DOD and NASA missions. The multiyear procurement of twenty-eight PAM-D II upper stages to support the GPS program was terminated. A total of sixteen upper stages will be completed and delivered by the end of FY 1988. The MSE program continued with payload specialist selection for DoD Shuttle missions and evaluation of military man in space initiatives. The VLS began transition to "minimum facility caretaker" status. Concept studies were initiated for a 10,000 lb-class upper stage.

(2) (U) FY 1988 Program: Shuttle is scheduled to resume operations with one launch planned in FY 1988 (NASA's Tracking and Data Relay Satellite). No Orbiter flight charge payment will be made to NASA in FY 1988 for flights in FY 1989 as the three DOD missions scheduled for launch in FY 1989 will be allocated flight credits. The decision to offload eight DSCS satellites from the Shuttle to expendable launch vehicles will allow four IUSs to be modified for future DSP satellites. These DSP satellites will be launched on Titan IV expendable launch vehicles. The 10,000 lb-class upper stage development will be terminated at the conclusion of the study phase due the lack of a need for such a Shuttle upper stage and due to the increased performance associated with the Titan IV Solid Rocket Motor Upgrade program. VLS attained "minimum facility" caretaker status and will be directed to further reduce the level of support to "Mothball" status. FY 1988 funding will also sustain the MSE program, Shuttle payload integration and mission support. Cost estimates are based upon prior experience for like efforts.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Shuttle flight credits will cover the required Orbiter flight charge payment for the five equivalent DOD Shuttle missions scheduled in FY 1990. The FY 1989 program will resume payment of secondary payload Shuttle flight charges to NASA. Secondary payloads include experiments, small payloads, and military man in space demonstrations performed in the Shuttle crew cabin. VLS will attain "mothball" status. Alternate users of the VLS facilities will assume financial responsibility for any operations expenses. Three DOD Shuttle missions will be integrated for flight. One of these missions will require an Inertial Upper Stage (IUS). The first Titan IV launch will occur in FY 1989 and this mission will also require an IUS. FY 1989 funding will Manned Spaceflight Engineer training for these and later DOD Shuttle missions. Aerospace support equipment will be developed to support the spaceflight of research and development experiments and military man in space demonstrations. Overall Shuttle technical support will be provided from the Aerospace Corporation. Cost estimates are based upon prior experience for like efforts (Category II, Mature estimates).

(4) (U) Program to Completion: This is a continuing program. Five DOD Shuttle flights are planned for FY 1990 and an average of two per year thereafter. Payload integration and mission operations will be required to support these payloads. VLS will be maintained in mothball status. Upper stage procurements and launch services will continue.

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Inertial Upper Stage (IUS) Defense Systems Acquisition Review Council (DSARC-II) | | March 1978 |
| (2) (U) Long lead award, 1st IUS production contract | | July 1980 |
| (3) (U) First Shuttle Flight | | April 1981 |
| (4) (U) First DoD use of the Shuttle | | June 1982 |
| (5) (U) First Titan/IUS flight | | October 1982 |
| (6) (U) Shuttle Initial Operational Capability (IOC) at Kennedy** | | November 1982 |
| (7) (U) First Shuttle/IUS flight*** | | April 1983 |
| (8) (U) Shuttle Processing Contract Award | | October 1983 |
| (9) (U) PAM-D II block buy contract | | December 1983 |
| (10) (U) First DoD operational Shuttle flight | | January 1985 |
| (11) (U) Vandenberg Launch and Landing Site IOC | | October 1985 |
| (12) (U) Shuttle (Challenger) accident | | January 1986 |
| (13) (U) Caretaker Status Decision for Vandenberg Launch Site | | July 1986 |
| (14) (U) Shuttle Flight Resumption (Planned) | *(June 1988) | August 1988 |
| (15) (U) DOD Resumption of Shuttle Flights (Planned) | | December 1988 |

* Date presented in FY 1988/FY 1989 Descriptive Summary
** NASA Milestone
*** Civil payload

(U) Explanation of Milestone Changes:

(14) (U) NASA delayed the resumption of Shuttle flights.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0701112F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Inventory Control Point Operations Embedded Computer Resources Support Improvement Program (ESIP)
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | 4,628 | 4,329 | 4,476 | Continuing | N/A |
| 3090 Embedded Computer Resources Support Improvement Program | 4,628 | 4,329 | 4,476 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Embedded Computer Resources (ECR) Support Improvement Program (ESIP) is a program to improve the support of embedded computer systems (ECS) in terms of mission responsiveness and productivity. This will be accomplished through exploiting current technology, applied management techniques and establish-ment of an information distribution network. This program encompasses four areas: (1) Automation and Standardization of ECS Support Processes, (2) Advanced Extendable Integration Support Facility, (3) ECS Readiness Support, and (4) ECS Support Networks.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 4,628 | 4,346 | 4,480 | Continuing | N/A |

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is the only Air Force research and development effort directed at improving Air Force Logistics Command's (AFLC's) embedded computer/software support capabilities which provide common support for multiple weapon systems. It complements AFLC's portion of ESIP to improve its ECS support infrastructure.

6. (U) WORK PERFORMED BY: Competitive contracts are managed by Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH. The contractors are SYSTRAN, Dayton, OH; TRW, Warner Robins, GA; Hughes, Warner Robins, GA; and ITT, Nutley, NJ.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:

(U) Project: 3090, Embedded Computer Resources Support Improvement Program (ESIP)

Program Element: 0701112F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Inventory Control Point Operations Embedded Computer Resources Support Improvement Program (ESIP)
Budget Activity: 6 - Defense-wide Mission Support

A. (U) Project Description: See paragraph 2.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Continued critical technology developments for insertion into prototype Advanced Extendable Integration Support Facility (AEISF). Transitioned technologies (Advanced Performance Monitor and Control (APMAC), electronic countermeasures (ECM) generator and data-driven network) directly to F-16 integration support facilities. Completed system level design/development of AEISF. Surveyed the reprogrammability of current and planned Communication-Navigation-Identification (CNI) systems and planned a detailed measurements program of signal/data flow responses to electronic warfare environments. Completed AEISF system critical design.

(2) (U) FY 1988 Program: Initiate Rapid Turnaround Methodologies Study for Radars. Initiate Roadmap for Advanced Reconfiguration Technology. Execute CNI measurements program planned in FY 1987.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Demonstration of enhanced APMAC integration with very high speed integrated circuits mission critical computer resources will occur in FY 1989. Preliminary design for modular distributed software geared to Ada and development of specifications and demonstration of small-scale prototype for same. CNI study results will be incorporated into a final report; however, the CNI data base will continue to be updated. Exploit high payoff areas from FY 1988 Advanced Reconfiguration Technology effort.

(4) (U) Program to Completion: This is a continuing program. Radar and CNI Rapid Turnaround development for the rapid reprogramming data-base will continue through FY 1990. The AEISF/APMAC, radar measurements and CNI measurements program will be integrated into the AEISF in FY 1990. High payoff advanced avionics reconfiguration technologies will be incorporated in the AEISF in FY 1992...

C. (U) Major Milestones:

| Milestones | | Dates |
|---|---|---|
| (1) (U) Baseline AEISF technology demonstration | | July 1986 |
| (2) (U) AEISF and ECM/Electronic Countercountermeasures (ECCM) studies complete | | August 1986 |
| (3) (U) Baseline APMAC technology demonstration | | October 1986 |
| (4) (U) Rapid Turnaround for CNI contract award | | October 1986 |
| (5) (U) Radar ECCM Analysis Program contract award | *(December 1986) | Cancelled |
| (6) (U) ECM Generator demonstration | | January 1987 |
| (7) (U) Built-In Support Function for Very High Speed Integrated Circuits (VHSIC) definition | | January 1987 |
| (8) (U) VHSIC/1750A APMAC development start | | February 1987 |

| | | | | |
|---|---|---|---|---|
| (9) | (U) | Advanced Extendable Integration Support Facility (AEISF) System Contract Award | *(September 1987) | July 1987 |
| (10) | (U) | Baseline Realtime Network to Ogden | *(December 1987) | September 1987 |
| (11) | (U) | Radar Rapid Turnaround Methodology | *(New) | September 1987 |
| (12) | (U) | Avionics Reconfiguration Technology Roadmap | *(New) | September 1987 |
| (13) | (U) | Modular Embedded Computer System (ECS) Software Study | *(July 1988) | January 1988 |
| (14) | (U) | Communication-Identification-Navigation (CNI) Electronic Countermeasures Test Complete | | December 1988 |
| (15) | (U) | Avionics Reconfiguration Technology Roadmap | *(New) | September 1988 |
| (16) | (U) | CNI Final Report complete | | June 1989 |
| (17) | (U) | Radar Rapid Turnaround Methodology | *(New) | September 1989 |
| (18) | (U) | Integrated Electromagnetic System Simulator linked to AEISF baseline | | December 1989 |
| (19) | (U) | AEISF/Advanced Performance Monitor and Control Very High Speed Integrated Circuits integrated technology demonstration | *(January 1990) | January 1989 |
| (20) | (U) | Modular ECS Software Complete | | September 1989 |
| (21) | (U) | Advanced Avionics Integration Support Facility | | December 1990 |

* Date presented in FY 1988/FY 1989 RDT&E Descriptive Summary

(U) Explanation of Milestone Changes:

(5) (U) Radar Electronic Countercountermeasures Analysis Program (REAP) contract award cancelled.
(9) (U) AEISF demonstrated in house. Developed in house; demonstrated for F-16A/B capability.
(10) (U) Work finished three months earlier than projected.
(11) (U) Radar Rapid Turnaround test methodology determined to be in best interest of AFLC (instead of REAP). Dual award contracts - September 1987.
(12) (U) Avionics Reconfiguration technologies to determine next generation AFLC support roadmaps awarded September 1987.
(13) (U) Project required six months earlier than projected.
(15) (U) Avionics Reconfiguration technologies roadmaps definition - September 1988.
(17) (U) Radar Rapid Turnaround definition complete - September 1989.
(19) (U) Other projects carry higher priority in AFLC ESIP office.
(20) (U) Modular Embedded Computer System Support prototype - September 1989.

8. (U) PROJECTS OVER $10 MILLION IN FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

# AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0702207F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Depot Maintenance
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 0 | 0 | 973 | Continuing | N/A |
| 3326 | Precision Measurement & Calibration Equipment Development | 0 | 0 | 973 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, tests, and evaluates measurement standards and associated equipment for 130 Base Precision Measurement Equipment Laboratories which are strategically located around the world. These standards are used in the calibration of every weapon system in the AF inventory, and must provide accuracies which are traceable to the National Bureau of Standards. These accuracies are the foundation for the calibrations necessary to place aircraft, bombs, and missiles on target in times of need. An extremely adverse impact on weapons accuracy, quality, reliability, maintainability, and associated life cycle costs can be expected if measurement support is unavailable. Inherent in the technology of modern weapons systems is the requirement for research and development of the calibration standards to support them. The equipment necessary to accomplish this task is not available. This FY 1989 new start will provide the means to accomplish this vital task in a timely manner.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | | | | | |
|---|---|---|---|---|---|
| RDT&E | 0 | 998 | 974 | Continuing | N/A |

EXPLANATION: (U) Congressional denial of funds in FY 1988, FY 1989 restart.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Research and development of metrology calibration standards is accomplished primarily by the National Bureau of Standards (NBS) in cooperation/collaboration with the Engineering Working Groups of the Calibration Coordination Group of the Joint Technical Coordinating Group for Metrology and Calibration (JTCG-METCAL). The JTCG-METCAL is a Tri-Service group under charter of the Joint Logistics Commanders. The specific work to be done is for tasks defined by nonduplicative work packages that are closely coordinated with Army and Navy METCAL programs. This approach where only one service manages and funds specific work was mandated by a Joint Logistics Commanders' Agreement, 8 January 1985.

6. (U) **WORK PERFORMED BY:** Work performed is primarily by NBS (about 60%), private industry (about 25%), universities/nonprofit institutions (about 10%), and less than 5% in-house at the Air Force Primary Standards Laboratory.

7. (U) **SINGLE PROJECT LESS THAN $10 MILLION IN FY 1989:**

(U) Project: 3326, Precision Measurement and Calibration Equipment Development.

A. (U) Project Description: The objective of this project is to develop, test, and evaluate precision measurement standards and associated equipment used in the measurement and calibration of advanced weapons systems and support equipment. There is a need to develop measurement and calibration capabilities for high technology areas such as lasers, microwave, millimeter wave, electro-optical, and automatic test equipment in order to support the accuracy, reliability, and quality of the advanced systems which use these technologies.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Accomplishments: Not applicable

(2) (U) FY 1988 Program: Not applicable

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 Program will begin work on the development of millimeter wave standards for Milstar and the low observable program, and the development of electro-optical standards to support laser-guided weapons such as Low Altitude Navigation and Targeting Infrared System for Night and infrared missiles such as the imaging Infrafed Maverick and the improved SIDEWINDER. This program will also support the development of improved, ruggedized field temperature sensors required to monitor advanced jet engine temperatures, and initiate efforts to establish more accurate DC voltage measurements. Further, it begins development of less environmentally sensitive, miniaturized test equipment for use in transportable Automated Test Equipment capable of in-place and on-site calibration.

(4) (U) Program to Completion: This is a continuing program. Successive year funding will complete initial development of millimeter wave standards, electro-optical standards, and improved temperature sensors by FY 1991. Development of miniaturized test equipment is anticipated to run to FY 1992. This program is updated and refined through the efforts of the Joint Logistics Commanders' Joint Technical Coordinating Group for Metrology and Calibration.

C. (U) Major Milestones: Not applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not applicable

9. (U) COOPERATIVE AGREEMENTS: Not applicable

AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support

Title: Industrial Preparedness
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 60,458 | 84,670 | 97,911 | Continuing | N/A |
| 2865 | Manufacturing Technology | 60,458 | 84,670 | 97,911 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Manufacturing Technology (MANTECH) is part of a larger Air Force Industrial Base Program that includes many activities that impact industrial preparedness and productivity; key elements in force readiness, modernization and sustainability. MANTECH is the only concentrated manufacturing R&D effort in the Air Force. Its purpose is to develop the manufacturing processes that determine what products can be produced and at what cost. History demonstrates that manufacturing process technology often precedes advances in product technology or performance. MANTECH helps transition state-of-the-art product designs into producible, high quality, cost-efficient weapon systems and components. MANTECH efforts are critical in maintaining a strong defense industrial base and in solving manufacturing challenges that hinder preparedness and productivity goals. MANTECH includes a Manufacturing Science thrust that is part of Science and Technology.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | | |
|---|---|---|---|---|---|
| RDT&E | 60,459 | 94,967 | 94,973 | Continuing | N/A |
| Aircraft Procurement | 41,691 | 40,000 | 36,500 | Continuing | N/A |
| Missile Procurement | 17,045 | 13,517 | 15,998 | Continuing | N/A |
| Other Procurement | 4,114 | 5,107 | 5,198 | Continuing | N/A |

(U) FY 1987 Aircraft and Missile Procurement lines increased as funds were reprogrammed from weapon lines to this line to complete industrial modernization and environmental protection projects. FY 1987 and FY 1988 Other Procurement lines were reduced as a result of fiscal constraints and will result in fewer electronic sector modernization activities. Congress reduced the FY 1988 RDT&E line by $10 million. No justification was provided. Impact was to terminate 10 project starts and descope another 14 manufacturing-related projects. The FY 1988 Missile procurement line increased as funds were reprogrammed in from the Defense Environmental Restoration line. The FY 1989 procurement lines are being reduced due to AF fiscal constraints. Reductions to the procurement lines will reduce the number of subcontractors that are encouraged to modernize through the Industrial Modernization Incentives Program, curb industrial preparedness planning as called for in the Defense Guidance, and reduce capital type rehabilitations and environmental compliance work at the 13 industrial plants that the Air Force is responsible for. FY 1989 RDT&E funding is increased to help revitalize critical DOD industries and to expand generic producibility and manufacturing research critical to the health of U.S. manufacturing capability.

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support

Title: Industrial Preparedness
Budget Activity: 6 - Defense-Wide Mission Support

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

| | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| Aircraft Procurement | 45,291 | 40,000 | 23,413 | Continuing | N/A |
| Missile Procurement | 17,645 | 16,017 | 10,731 | Continuing | N/A |
| Other Procurement | 2,014 | 2,173 | 4,538 | Continuing | N/A |

5. (U) RELATED ACTIVITIES: Both the Army and Navy have Industrial Preparedness and Manufacturing Technology (MANTECH) programs (PE #0708011A and PE #0708011N) that are coordinated with this program. Other government agencies such as NASA and the National Bureau of Standards also pursue MANTECH-related efforts. All MANTECH programs are coordinated through the DOD MANTECH Advisory Group which includes government and industry participants. Technology base programs help provide the research and development that MANTECH then scales-up, integrates, validates, demonstrates, and establishes as new or improved production capability. MANTECH provides production technologies for implementation by the Technology Modernization Program that can contractually encourage aggressive capitalization and modernization by DOD weapon system and component producers. MANTECH supports generic manufacturing technology that impacts nearly all future hardware production and maintenance activities.

6. (U) WORK PERFORMED BY: The program is executed by Air Force Systems Command, Andrews AFB, MD, and Air Force Logistics Command, Wright-Patterson AFB, OH, for implementation primarily by private industry at contractor and Air Force Air Logistics Center locations. Agencies participating include the Wright Aeronautical Laboratories, Wright-Patterson AFB, OH, Air Force Product Divisions, and the Air Logistics Centers. Technical effort is accomplished almost exclusively by competitive contract and nearly all major aerospace prime and sub-tier contractors participate. The top six contractors are General Electric Company, Evendale, OH; United Technologies Corporation, West Palm Beach, FL; Martin Marietta Corporation, Orlando, FL; Westinghouse Electric Company, Baltimore, MD; Boeing Aircraft Corporation, Seattle, WA; and General Dynamics Corporation, Fort Worth, TX.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1989:

(U) Project: 2865, Manufacturing Technology

A. (U) Project Description: The Manufacturing Technology (MANTECH) program is a broad based production improvement, industrial-enhancing program that provides new/innovative manufacturing technologies that result in more economical, timely, and reliable production and design of Air Force systems. Projects result in factory floor application of productivity enhancing improvements. MANTECH fosters the use and development of enhanced manufacturing equipment, processes and techniques and continuously advances the state of the art in manufacturing by bridging the gap from R&D

to production. Manufacturing Technology (MANTECH) stimulates industrial innovation by the government sharing the cost and risk involved in advancing and applying improved production methods, equipment and processes. Current thrusts include: (1) Airframe Production and Productivity, (2) Low Observable Configurations, (3) Propulsion, (4) Electronics, (5) Maintenance and Repair, (6) Computer Integrated Manufacturing, (7) Strategic Missile and Launch System Productivity, (8) Space System Manufacturing Productivity, (9) Tactical Systems, and (10) Manufacturing Science.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1987 Program Accomplishments: In the Airframe and Productivity Thrust established advanced methods and more economical processes to fabricate, shape and assemble required high quality thermoplastic composite and metallic aircraft and missile components. In the Propulsion Thrust, advanced the development of low cost manufacturing processes used to produce turbine engines. Included work on casting methods needed to accompany advances in high density, high strength superalloys used for engine turbines and airfoils. In the Electronics Thrust, efforts continued to establish a more reliable screening process for complex Very High Speed Integrated Circuit chips. Advances were made in the controled processing, to achieve higher yields and larger volume production ability, of Gallium Arsenide wafers. In the Logistics Maintenance and Repair Thrust advanced commercial techniques, developed with government coordination, are being transfered and demonstrated at an Air Logistics Center (ALC). An engine repair center began development that uses the latest flexible machining technologies. A robotically controlled paint stripping system was developed for potential ALC use. Computer geometric modeling techniques were applied to the automated inspection of turbine blades. In the Computer Integrated Manufacturing Thrust, a software/hardware integration development began to support a Composite Fabrication Center and Airframe Assembly Center. Computer-oriented information and benefits tracking software was developed for use and support of MANTECH projects. In the Space Systems Thrust, a radiation hardening manufacturing technology project was completed resulting in superior chip design and improved survivability characteristics. In the Tactical Thrust, efforts proceeded to demonstrate advanced processing, packaging, and testing of millimeter wave diodes, essential elements in avionics systems. In the Manufacturing Science Thrust, work was initiated that will result in computer simulation ability directed at autoclave curing of composite materials. Tool and die design computer aided manufacturing development began. Work to establish an Institute for Artificial Intelligence in Manufacturing continued as we explored using Cooperative Agreements among industy, universities, and government agencies.

(2) (U) FY 1988 Program: The FY 1988 Manufacturing Technology program represents the minimum effort needed to meet the manufacturing research needs of the Air Force. Concurrent manufacturing process technology development is essential to corresponding product research and development that will occur during this period of time. Without such development, design technologies out-strip product capabilities. The result is often adverse media stories about quality and inefficiency at many of DOD's leading production locations. In the Air Frame Production and Productivity Thrust, work will continue on economical production methods of aircraft composite wing and fuselage structures. Evaluations will be conducted to determine manufacturing process impact on advanced composite materials being used on Air Force systems. In the Low-Observable Thrust, effort will be devoted to decrease the cost involved in the layup of radar absorbing materials. In the Propulsion Thrust, improved methods will be established to produce engines using promising new carbon-carbon and titanium aluminide materials. Nozzles, vanes and integrally bladed rotors will benefit

from new materials and processes. This thrust will demonstrate improved casting techniques that can produce defect-free titanium ingots. In the Electronics Thrust, work will continue to improve fabrication and inspection of high speed integrated circuit printed wiring board substrate fabrication. This work is evaluating risk involved with manufacturing techniques associated with hermetic chip carriers and advanced packaging of electronic components. This effort will also continue high volume manufacturing research of gallium arsenide devices. In the Logistics Thrust, work will continue on airframe and engine repair technology. Software will be developed to allow geometric modeling of turbine blades and disks to establish a repair data base. Means will be established to obtain consistent, reliable transducers for nondestructive inspection. Air Logistics Center opportunities for robotic and laser applications will be explored. In the Computer Integrated Manufacturing thrust, a digital data exchange standard will be developed to reduce the number and complexity of engineering drawings. Technology and support software will be developed to complement earlier flexible assembly of components projects. Sensing and control technologies will be integrated to advance intelligent task automation. Advanced machining concepts for subcontractors will be continued. In the Strategic Missile Thrust, an automated system will be developed to produce chaff. In the Space Systems Thrust, work will continue on radiation hardened chip and mercury cadmium telluride arrays. In the Manufacturing Science Thrust, software will be developed for an artificial intelligence based machining system. Full automation fabrication of optical filters will be investigated. Establishment of an Institute for Artificial Intelligence in Manufacturing will continue using cooperative agreements between participating industries, universities and government agencies. The program also helps monitor and execute a Domestic Action Plan approved by the President to revitalize the United States tool industry. The Air Force is helping to develop a technical agenda to support a National Center for Manufacturing Science (NCMS) that will conduct advanced manufacturing technology research with the long-range goal of helping the American tool industry regain its past market strength. In accordance with Congressional instructions these funds are being provided to NCMS as a grant.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Manufacturing Technology (MANTECH) Program for FY 1989 continues to target generic manufacturing technology and process voids that impact the cost-effective production of Air Force weapon systems. A majority of FY 1988 projects will be continued and/or completed as part of the FY 1989 program. Eight of the ten thrust areas presented in the FY 1988 section will also be pursued in FY 1989. The FY 1989 program includes over 30 manufacturing R&D endeavors. For example, the large aircraft composite program will continue to pursue economical manufacturing methods enabling the application of greater composite use on future bomber and transport aircraft. Establishing automated fabrication of very large wing and fuselage structures can reduce current fabrication costs by 50% and reduce aircraft weight by 20% enabling greater aircraft performance. Thermoplastic forming manufacturing R&D will continue promising dramatic "toughness" improvements that will lead to lower supportability costs. In the Propulsion Thrust, generic manufacturing research with advanced materials will continue. This thrust is reviewing cost and design-critical fan and duct manufacturing processes that could provide 60 pound weight reductions and 30% manufacturing cost reductions to programs using the new processes. Maybe more important is the thrust to weight ratio gained by user engines. The program will analyze the use of new blade alloys and automation of production of engine cases, frames, ducts, liners and nozzles. This thrust includes continuation of rapid solidification process manufacturing technology development that is considered to be one of the major alloy and strength breakthroughs in engine technology in recent years. Rapid solidification involves taking metal alloys from

liquid to solid in one millionth of a second for improved strength, corrosion-resistance, and lower operating costs. In the Electronic Thrust, work will be completed on improving printed circuit board economic producibility. The thrust focus is to develop boards that have minimal solder joint failures at leadless chip carrier attachment points. Improved yields will result. The Maintenance and Repair Thrust focuses on improving capabilities in flaw detection and nondestructive evaluation procedures and equipment. Work to establish an In-Service Inspection System will allow composite structures to be evaluated for wear without expensive component removal. Continued work on a Flexible Repair Center will lead to reduced engine case repair time from as much as 120 days to 72 days and eliminate 3 to 5 repair operations allowing a fourfold increase in machining productivity. Logistics Product Support development will lead to greater computer aided design at repair centers and result in fewer errors in interpreting engineering drawings and foster quicker repairs. These improvements translate into reduced spare part lead times (75% reduction is the goal) and reduced spare part inventories (60% reduction is the goal). When fully implemented the cost avoidance expected will be dramatic and in the billion dollar range. In the Computer Integrated Manufacturing (CIM) Thrust, demonstration work will continue in an effort to fully take advantage of state-of-the-art, more cost-effective CIM technology. The thrust demonstrates the payoffs possible at government contractors when the latest CIM technology is used. Cutting production lead times by 50%, eliminating 50% of non-touch labor, reducing touch labor by 25%, reducing raw material and in-process inventories by 50%, and reducing floor space requirements by as much as 30% are reachable goals being pursued in this thrust. The Machining Vendor initiative tailors the latest technology in metal cutting, cutting tools, machining data, machining systems, and management information to the needs of small subcontractors. Expanded efforts to revitalize the machine tool industry will be continued. In the Strategic Missile and Launch Systems Thrust, generic manufacturing methods advancements for space and satellite electronics will continue. The focus will be on producibility and increasing yields of new electronic systems using focal plane arrays, radiation hardened chips, peripheral circuits for memories, and metal matrix composite technologies. The radiation hardened chip set work will demonstrate improved manufacturing methods on bulk silicon circuits that are essential to producing affordable future missile and space systems. The Air Force will continue to expand the science base for manufacturing process development. Projects include manufacturing development in the areas of smart assembly, computer-aided engineering for die design, and more cost-effective manufacture and enhanced yield of mercury-cadmium/telluride detector arrays. Other projects focus on structural composites manufacture, an intelligent machining work station, complex shaped thermoplastics, and rugate filters. Cooperative efforts to support artificial intelligence technology and the private sector-operated National Center for Manufacturing Sciences will continue.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1989 Manufacturing Technology Program
TITLE: INDUSTRIAL PREPAREDNESS

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support



Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported
Project (Title)
I.D. (End Items Supported)

| | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| **AIRCRAFT PROCUREMENT, AIR FORCE** | | | | | | | |
| A | 0001 | Large Aircraft Fuselage Manufacturing C-17, Advanced Technical Bomber (ATB), Future Large A/C | 2782 | 2050 | 900 | 0 | 13557 |
| A | 0005 | Mfg. Methods for Thermoplastics Advanced Tactical Fighter (ATF), Future Systems | 100 | 1800 | 3700 | 3400 | 9000 |
| A | 0234 | Radome Manufacturing Process Application Classified | 0 | 1000 | 128 | 0 | 0128 |
| A | 0008 | Manufacturing Technology for Advanced Propulsion Materials Advanced Fighter Engine, Future Systems | 7379 | 9160 | 13077 | 7550 | 49547 |
| A | 0011 | Solid State Microwave System ATF Radar, Satellites | 4642 | 4683 | 3240 | 429 | 16175 |
| A | 0043 | Aluminum Production Bullet, All Aircraft Systems | 0 | 500 | 721 | 0 | 1221 |
| A | 0294 | Advanced Transparencies, ATF, Advanced Aircraft | 100 | 1250 | 1250 | 1750 | 4350 |
| A | 0247 | Continuous Ceramic Fiber Production, Future Systems | 0 | 0 | 100 | 6000 | 6100 |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support



Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported | Project (Title) I.D. (End Items Supported) | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| **AIRCRAFT PROCUREMENT, AIR FORCE** | | | | | | | |
| A | 0092 | Hermetic Chip Carrier Compatible Printed Wiring Board All Systems | 400 | 1000 | 583 | 0 | 5310 |
| A | 0021 | Machining Vendor Initiative F-16, Advanced Tactical Fighter (ATF), B-1 | 3794 | 3606 | 2713 | 0 | 12719 |
| A | 0022 | Integrated Composite Center F-16, F-15, F-18, AV-88, ATF | 1250 | 2000 | 1000 | 357 | 8007 |
| A | 0024 | Intelligent Task Automation Electronic Assemblies | 150 | 1080 | 0 | 0 | 4792 |
| A | 0181 | Automated Airframe Assembly ATF, Future Systems | 495 | 2000 | 6850 | 5062 | 14407 |
| A | 0251 | Manufacturing Technology for Superplastic Formed Aluminum Advanced Aircraft | 0 | 100 | 2000 | 5100 | 7200 |
| A | 0250 | MT for High Temperature Aluminum Fabrication, Future Systems | 0 | 0 | 100 | 8400 | 8500 |
| A | 0269 | Advanced Oxidation Resistant Alloy Powder, Classified Applications | 0 | 1100 | 900 | 900 | 2900 |
| A | 0246 | Metal Matrix Shafts & Cast Rotor, F-112 Engine and Other Small Engines | 0 | 0 | 100 | 2900 | 3000 |
| A | 0273 | Premium Quality Ti Alloy Disk Material, Advanced Engines | 0 | 0 | 1200 | 5400 | 6600 |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support
Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported / Project (Title) / I.D. (End Items Supported) | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| **AIRCRAFT PROCUREMENT, AIR FORCE** | | | | | | | |
| A | 0249 | High Temperature Structures Manufacturing, Advanced Aircraft | 0 | 0 | 100 | 14900 | 15000 |
| A | 0248 | Process Effects on Properties, All Aircraft | 250 | 250 | 255 | 545 | 1300 |
| A | 0268 | MT for Low Cost Tooling Concepts for Advanced Composites Production, Advanced Aircraft | 0 | 100 | 1000 | 6000 | 7100 |
| A | 0287 | Digital Product Models, ATF, Future Systems | 2000 | 0 | 2000 | 4000 | 8000 |
| A | 0301 | On Line Information System, All Systems | 0 | 0 | 750 | 2500 | 3250 |
| Total Aircraft Procurement, Air Force, Related | | | | 30229 | 39667 | | |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support


Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported / Project (Title) / I.D. (End Items Supported) | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| MISSILE PROCUREMENT, AIR FORCE | | | | | | | |
| A | 0229 | Chaff Coil Manufacturing Peacekeeper, Small Intercontinental Ballistic Missile | 100 | 1906 | 1117 | 666 | 3489 |
| A | 0302 | Large Sensor Windows, Advanced Reentry Vehicles | 0 | 0 | 100 | 1850 | 1950 |
| A | 0303 | Advanced Binder Materials, Future Tactical Strategic Missiles | 0 | 0 | 100 | 3100 | 3200 |
| A | 0032 | MT for HgCdTe Focal Plane Arrays, BSTS, Tactical Systems | 1400 | 3485 | 3655 | 8615 | 17155 |
| A | 0033 | MT for Enhanced Radiation Hardened Chip Set, MILSTAR, DSCS, SICB | 100 | 623 | 500 | 0 | 2993 |
| A | 0200 | MT for Bubble Memory Peripheral Electronics, DSCS, GPS, Advanced Satellites | 50 | 662 | 760 | 406 | 1878 |
| A | 0221 | MT for Radiation Hardened SOI Wafers, DSCS MILSTAR, Advanced Satellites | 0 | 0 | 1000 | 7600 | 8600 |
| A | 0275 | MT for Rugged, Thin GaAs Solar Cells, Advanced Satellites | 0 | 0 | 1000 | 2000 | 3000 |
| Total Missile Procurement, Air Force, Related | | | | 4576 | 8232 | | |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support
Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported<br>Project (Title)<br>I.D. (End Items Supported) | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| **O&M AIR FORCE** | | | | | | | |
| A | 0255 | Robotic Applications/Shot Peen, Engine Repair | 0 | 0 | 750 | 3150 | 3900 |
| A | 0015 | Robotic Application/Paint Stripping, F-16, F-4, F-111 Repair | 700 | 509 | 412 | 0 | 1621 |
| A | 0237 | Robotic Application/Derivet, Airframe Repair | 999 | 1220 | 591 | 0 | 2810 |
| A | 0016 | Geometric Modeling, Engine Depot Maintenance | 1400 | 2376 | 1500 | 1000 | 6276 |
| A | 0187 | Static and Accessory Repair, Engine Depot Maintenance | 500 | 2500 | 2500 | 1200 | 6800 |
| A | 0224 | Laser Applications, Depot Maintenance | 0 | 0 | 100 | 9100 | 10000 |
| A | 0226 | ALC Flexible Repair Center, Engine Case Repair | 2038 | 3271 | 2423 | 1643 | 9375 |
| A | 0276 | CALS Initiative, Spares Acquisition | 0 | 0 | 1000 | 3500 | 5600 |
| A | 0296 | Single Crystal Blade Repair, Engine Repair | 0 | 0 | 100 | 1900 | 2000 |
| A | 0297 | Composite Repair Data, Airframe Spares | 0 | 0 | 100 | 1700 | 1800 |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported<br>Project (Title)<br>I.D. (End Items Supported) | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| O&M AIR FORCE | | | | | | | |
| A | 0298 | Advanced Engine Component NDE Instrumentation, Depot Inspection | 0 | 0 | 100 | 4600 | 4700 |
| A | 0299 | MT for Durable Horeycomb Structure, Airframe Spares | 0 | 0 | 100 | 3500 | 3600 |
| A | 0311 | Robotic Applications, Fuel-tank Desealing | 0 | 300 | 1500 | 700 | 2500 |
| Total O&M, Air Force, Related | | | | 13430 | 11176 | | |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support



Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported / Project (Title) / I.D. (End Items Supported) | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| **GENERIC PROCUREMENT** | | | | | | | |
| A | 0010 | Advanced Data Signal Processing, VHSIC, All Systems | 5170 | 4830 | 2853 | 0 | 21858 |
| A | 0245 | MT for Holographic Wafer Inspection, All Systems | 0 | 200 | 700 | 0 | 900 |
| A | 0252 | Electronics Subsystems Producibility, All Systems | 0 | 100 | 4900 | 7200 | 20000 |
| A | 0295 | Microelectronics Manufacturing Science, All Systems | 0 | 1500 | 6000 | 25000 | 32500 |
| A | 0309 | MT for Producibility of PWA, All Systems | 0 | 0 | 2000 | 3000 | 5000 |
| A | 0026 | Manufacturing Technology Special Studies, All Systems | 0 | 1096 | 700 | 1400 | 3196 |
| A | 0028 | MT Program Assessment, All Systems | 50 | 1500 | 1200 | 1085 | 3825 |
| A | 0309 | Machine Tool Initiative, All Systems | 0 | 0 | 500 | 49500 | 50000 |
| A | 0310 | Photo Backscatter, All Systems | 0 | 100 | 700 | 700 | 1500 |
| Total Generic Procurement, Air Force, Related | | | | 9326 | 19553 | | |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support



Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported
Project (Title)
I.D. (End Items Supported)

| | | | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|---|---|
| **R&D, AIR FORCE** | | | | | | | |
| A | 0041 | Institute of Artificial Intelligence in Manufacturing Generic Applicability | 0 | 10 | 2000 | 7990 | 9990 |
| A | 0191 | Rugate Filters Generic Applicability | 855 | 585 | 422 | 490 | 2352 |
| A | 0183 | Complex Shaped Thermoplastics Generic Applicability | 900 | 1050 | 311 | 0 | 2261 |
| A | 0263 | Automated Airframe Assembly, Generic Applicability | 255 | 800 | 1650 | 2200 | 4905 |
| A | 0304 | Knowledge Integrated Design System, Generic Applicability | 0 | 100 | 1000 | 3800 | 4900 |
| A | 0305 | Manufacturing Science for Carbon-Carbon, Generic Applicability | 0 | 0 | 100 | 3700 | 3800 |
| A | 0306 | Advanced Composite Processing, Generic Applicability | 0 | 0 | 1000 | 1100 | 3100 |
| A | 0307 | Framework for Integrated Manufacturing Systems, Generic Applicability | 0 | 0 | 100 | 9400 | 9500 |
| Total RD, Air Force, Related | | | | 3945 | 8083 | | |

Program Element: 0708011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

| Procurement Appropriation Supported<br>Project (Title)<br>I.D. (End Items Supported) | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Complete | Total Est Cost |
|---|---|---|---|---|---|
| **DIRECTED PROGRAM, AIR FORCE** | | | | | |
| A 0274 National Center for Manufacturing Science Grant, Generic Applicability | 0 | 5000 | 5000 | 5000 | 15000 |
| **PROGRAM SUPPORT** | 3498 | 3160 | 3200 | N/A | 9858 |

FY 89 Grand Total
Program Element 78001F
Manufacturing Technology
97911

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 0708026F
DOD Mission Area: 490 - Production Base Support.

Title: Productivity, Reliability, Availability Maintainability (PRAM)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 14,263 | 14,706 | 16,398 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In early 1985, the Air Force initiated a program called Reliability and Maintainability (R&M) 2000. The purpose of R&M 2000 is to accelerate R&M improvements in new and fielded weapon systems. PRAM is one of principle means of rapid, R&M technology inser-tion. The PRAM program was established in 1975 to reduce rising ownership costs and to improve productivity, reliability, availability and maintainability of operational systems. It is one of the few Air Force RDT&E programs that can rapidly respond to fielded weapon system R&M opportunities by qualifying and prototyping new, off the-shelf technology. To this end, PRAM has responded with timely investments in projects resulting in significant increases in combat capability and lower life cycle costs. Since its inception, PRAM has invested approximately $158 million in over 840 projects which have provided the Air Force with direct saving of approximately $14.4 billion in operations and support (O&S) cost avoidance.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 14,264 | 19,560 | 20,413 | Continuing | N/A |

EXPLANATION: Reductions in FY 1988 funding is due to lower growth in the Air Force budget and a $4.8 million reduction in appropriations. The FY 1989 reduction is due to lower than anticipated budget growth. These reductions slow the rate of R&M improvement and result in lost opportunities to increase combat capability while decreasing support costs.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) **RELATED ACTIVITIES:** PRAM plays a complementary role with the Aircraft Engine Component Improvement Program (CIP) in PE 0604268F. The CIP is concerned with R&M improvement in operational aircraft engines. PRAM's charter specifically precludes projects that are covered by the engine CIP. To ensure their complementary operation, PRAM propulsion projects are closely coordinated with the Air Force Propulsion Lab and the Aeronautical Systems Division's Propulsion Program Office. A dialogue has also been established with the Army and Navy through which program activities and accomplishments are exchanged.

6. (U) **WORK PERFORMED BY:** The PRAM program office is located at Wright-Patterson AFB, OH. Satellite PRAM offices are located at each of the five Air Force Air Logistics Centers, the Aerospace Guidance and Metrology Center in Newark, OH, and HQ Strategic Air Command at Offutt AFB, NE. The Air Force Flight Dynamics, Avionics, Materials and Propulsion Laboratories, as well as the Air Force Flight Test Center, Aeronautical Systems Division, and the Space Division participate in PRAM projects. The largest PRAM contractors are: G.A. Technology, San Diego, CA; Northrop Corp., Hawthorne, CA; McDonnell Douglas Corp., St Louis, MO; and Westinghouse Corp., Baltimore, MD.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1989:** Not Applicable.

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1989:**

(U) Project: 0708026F, PRAM

A. (U) Project Description: The PRAM program responds to requirements for increased combat capability and reduced cost of ownership in new and fielded weapon systems. The program objectives are being pursued through investments in over 135 active projects that: (1) improve the R&M of fielded weapon systems through modifications and parts substitution; (2) improve the R&M of maintenance and logistics support organizations at all levels through improved procedures and documentation; and (3) exploit lower life cycle cost alternatives in systems configurations through component commonality methods and techniques. Implementation of these projects leads to: improved combat capability in our fielded systems; increased survivability of the combat support structure; more efficient use of mobility and manpower assets; and lower operations and support costs. PRAM projects are in the avionics, propulsion, missiles and space, depot maintenance, and other support areas.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1987 Accomplishments: In FY 1987, PRAM financed 39 new projects that prototype, evaluate, and qualify needed R&M fixes to Air Force fielded systems. Examples of these R&M projects are: development of a more reliable Engine Inlet Ring for the A-10; qualifying improvements to the F-16 Invertor/Controller Automatic Test System; evaluating and qualifying a new High Reliability Maintenance Free Battery for Air Force aircraft; and qualifying Heat-To-Shrink Couplings technology for leak-free repair of damaged aircraft hydraulic lines.

(2) (U) FY 1988 Program: Among the high priority PRAM efforts in FY 1988 is the fabrication and qualification of an Aircraft Hot Bonded Repair System (for both composite and metal components) and prototyping a Stationary Neutron Radiography System at Sacramento Air Logistics Center for detection of small cracks and corrosion in aircraft parts. Additionally, a Robotic Paint Booth prototype at Warner Robins Air Logistics Center will improve aircraft maintenance productivity while a C-130 Autopilot upgrade replaces tube technology with solid state electronics. Other efforts include an analysis of A-7D Generator bearings using spectra and vibration techniques and leading to preventive maintenance criteria. Another project redesigns the C-141 Landing Gear Actuator to double its reliability and decrease unit cost by 50%.

(3) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: PRAM will have 15 carryover efforts for application of FY 1989 funding. These projects include an improved technical data system for a classified application, a robotic welding machine at Warner Robins Air Logistics Center. New projects include a video tape capability during borescopic inspections of aircraft engines to improve malfunction diagnostics and a transparent nylon replacement for the current C-141 Wing Tip Light Lens made of g'ass.

(4) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

## AMENDED FY 1988/FY 1989 BIENNIAL BUDGET RDT&E DESCRIPTIVE SUMMARY

Program Element: 1001004F
DOD Mission Area: 460, International Cooperative RDT&E

Title: International Activities
Budget Activity: 6, Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

| Project Number | Title | FY 1987 Actual | FY 1988 Estimate | FY 1989 Estimate | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|---|
| TOTAL FOR PROGRAM ELEMENT | | 2,721 | 3,107 | 3,737 | Continuing | N/A |
| 2446 | von Karman Institute | 375 | 425 | 450 | Continuing | N/A |
| 2447 | SHAPE Technical Centre/ AGARD/Cooperative R&D | 2,346 | 2,682 | 3,287 | Continuing | N/A |

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program satisfies Department of Defense (DOD) administrative agent responsibilities for the North Atlantic Treaty Organization (NATO) Advisory Group for Aerospace Research and Development (AGARD) in Paris, France and for the Supreme Headquarters Allied Powers Europe (SHAPE) Technical Centre (STC) in The Hague, Netherlands; pays for United States scientists at STC; supports United States Air Force participation in cooperative Research and Development (R&D) agencies and groups; and pays the United States' share of NATO support for the von Karman Institute in Brussels, Belgium. Support of this program is a continuing international commitment under the auspices of NATO and our mutual weapons development agreements with our allies.

3. (U) COMPARISON WITH FY 1988/FY 1989 DESCRIPTIVE SUMMARY: ($ in thousands)

| | FY 1987 | FY 1988 | FY 1989 | Additional to Completion | Total Estimated Cost |
|---|---|---|---|---|---|
| RDT&E | 2,721 | 3,123 | 3,156 | Continuing | N/A |

EXPLANATION: (U) Significant drops in the exchange rates have caused major impact to US-funded international commitments and the management support to these commitments. New pricing models are now being used, as well as new Cost of Living Adjustments (COLA). Additionally, there has been an increased focus on international cooperative agreements by direction of the Secretary of Defense; and to support this increased emphasis, some contractor support is required.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not applicable.

5. (U) RELATED ACTIVITIES: Supports international cooperative R&D agreements, Information Exchange Projects, the U.S. Mutual Weapons Development Data Exchange Program, the Technology Cooperation Program with the United Kingdom, Canada, Australia, and New Zealand, the Defense Research Group, and the U.S. Air Force Senior National Representative to the Under Secretary of Defense for Acquisition. Also supports USAF participation in NATO Armaments research, development and acquisition initiatives including representation on groups and subgroups under the NATO Conference of National Armaments Directors and the NATO Air Force Armaments Group.

6. (U) WORK PERFORMED BY: Leading US civilian and military scientists, engineers, and administrators; and the TECHPLAN Corporation of Marlton, NJ. The Assistant for International R&D Cooperation in the Office of the Assistant Secretary of the Air Force (Acquisition) administers the program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1989.

A. (U) Project: 2446, von Karman Institute. Funds U.S. share of North Atlantic Treaty Organization (NATO) support to the von Karman Institute for Fluid Dynamics in Brussels, Belgium. This international research facility is instrumental in advancing the state of the art in fluid dynamics and related disciplines. The von Karman Institute was founded in 1956 under NATO auspices as an international, non-profit, scientific organization. Financial support comes from the supporting nations (57%), Belgian national support (13%) and research grants or international contracts (30%). U.S. share of the 57% internationally-funded portion is 12.5%, for cooperative basic research with other NATO nations. U.S. von Karman Institute Fellowships support up to five U.S. participants annually. In FY 1987 the Institute graduated over 70 internationally trained scientists, conducted ten lecture series involving over 1000 NATO scientists/engineers, and published numerous technical reports. Continuing the U.S. contribution will provide a flow of internationally educated scientists who return this expertise to their own countries. A program of cooperation between the von Karman Institute and the Air Force Institute of Technology (AFIT) was initiated in FY 1986; and a similar program is envisioned with the U.S. Air Force Academy for FY 1988/FY 1989.

B. (U) Project: 2447, SHAPE Technical Centre/Advisory Group for Aerospace Research and Development (AGARD)/Coopertive Research and Development (R&D). The Supreme Headquarters Allied Powers Europe (SHAPE) Technical Centre (STC) is a multinational organization responsible directly to the Supreme Allied Commander, Europe. The Centre provides scientific and technical advice on military problems with emphasis on Command, Control and Communications. The United States Air Force (USAF), as administrative agent, supports 21 of 110 international scientist and engineer positions at STC. AGARD provides technical advice and assistance to the NATO Military Committee, promotes advances and cooperation in aerospace sciences and provides assistance to requesting NATO member nations to help increase their aerospace scientific and technical potential. The USAF is also administrative agent for AGARD and funds non-government as well as USAF participation in the AGARD scientific and technical meetings. This includes contracting for special services such as language translation for meetings in the United States. In addition, this program pays for USAF participation in data exchange and engineer exchange agreements with free world countries, and participation in those NATO agencies and groups in which USAF membership and participation is directed by treaty or other agreement. The continued funding of the 21 US scientists/engineers at STC will ensure that we have firsthand knowledge of NATO command and control systems; and supporting the participation of up to 100 experts in AGARD technical panels and working groups will foster cooperative programs. In addition, U.S. treaty obligations will also be achieved in international cooperative RDT&E through participation in NATO working groups, conferences, and the Scientist/Engineer Exchange Program.

8. (U) PROJECT OVER $10 MILLION IN FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: This program, as the title indicates, deals entirely with International Cooperative RDT&E. See above for detailed explanation.

MAJOR IMPROVEMENTS AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES FUNDED BY RDT&E

Department/Agency: Air Force  Date: Feb 88

Part I. UTILIZATION OF SECTION 2353, TITLE 10 AUTHORITY

Specialized R&D facilities and/or equipment determined to be necessary for the performance of a contract for a military department for research and development may be constructed by or furnished to the contractor and funded from appropriations available for research, development, test and evaluation. The Congress enacted this legislation, 10 USC 2353, in 1956. This policy is executed through DOD Directive 4275.5. Under this policy, the Secretaries of Military Department or their designees; and the Directors of Defense Agencies may approve facilities projects up to $3,000,000; the Under Secretary of Defense for Acquisition approves projects exceeding $3,000,000. The Congress is notified in advance of starting any project involving construction, regardless of the dollar amount. The table below provides a summary of all such projects accomplished in FY 86 and planned through FY 89.

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | Total Obligational Authority (Thousands of Dollars) 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| | | | SECTION I | | | | |
| | | | Projects Accomplished or Underway | | | | |
| Building 1302D-Addition to Electronic Research Lab 1/* | 0603311F 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | 900.0 | | | |
| Building 1302C-Addition to Electronic Research Lab 1/* | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | 1,416.2 (1) | 170.0 (1) | | |
| Addition to Secure Vault & Electronics Area 1/* | 0102424F | MIT Lincoln Laboratory | Haystack Observatory Millstone Hill Westford, MA | 192.4 | | | |
| Extension to Millstone Computer Area 1/* | 0102424F | MIT Lincoln Laboratory | Millstone Hill Westford, MA | | 280.0 | | |
| Titan SRM X-Ray Facility 1/ | 0304111F | Chemical Systems Division | Vandenberg AFB CA | 1,250.0 | 4,070.0 | | |
| Alter Integrate-Transfer-Launch (ITL) Facilities 1/ | 0305119F | Martin Marietta | Cape Canaveral AFS, FL | 17,400.0 | 19,300.0 | 11,100.0 | 7,100.0 |

## MAJOR IMPROVEMENTS TO AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES

### FUNDED BY RDT&E

### PART 3. UTILIZATION OF RDT&E APPROPRIATION FOR MINOR CONSTRUCTION

For in-house installations, construction projects in support of R&D for $200,000 or less are funded from RDT&E appropriations. Such expenditures are authorized by 10 USC 2805 and the applicable provisioos of the current DOD Appropriation Act. Under this project approval at this level is authorized by the Major Command concerned, or delegated to R&D installation commanders as appropriate. The table below provides a summary total of such minor construction accomplished in FY 86, and the estimated amounts planned through FY 89. All minor construction projects must result in a complete and useable facility. In no event are two or more minor construction projects or minor and major constructioo projects to be contrived to form a usable facility:

#### SUMMARY OF MINOR CONSTRUCTION FUNDED BY RDT&E, AIR FORCE

| | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|
| TOTAL PART 3 | 12,113.8 | 23,602.0 | 10,869.1 | 9,186.7 |
| SUBTOTAL PART 1 | 21,158.6 | 99,168.0 | 44,024.0 | 20,100.0 |
| SUBTOTAL PART 2 | 127,837.9 | 86,293.7 | 103,823.0 | 92,104.0 |
| SUBTOTAL PART 3 | 12,113.8 | 23,602.0 | 10,869.1 | 9,186.7 |
| GRAND TOTAL | 161,110.3 | 209,063.7 | 158,716.1 | 121,390.7 |

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| | | | | | Total Obligational Authority (Thousands of Dollars) | | |
| | | | D. Temporary | | | | |
| ATF DEM/VAL Facilities.2/ | 0603230F | | Edwards AFB, CA | | | | 9,800.0 |
| Temporary Construction C-17A Airdrop Test Complex 1/ | 0604231F | | Edwards AFB, CA | | | | 4,730.0 |

NOTE: * Cost, Scope and/or FY Change

1/ Listed in previous submittal
2/ Initial submittal

(a) Funding anticipated as a result of OSD directed Space Systems test capabilities (SSTC Study)

(b) Funding anticipated from combination of customers and/or AEDC resources.

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | Total Obligational Authority (Thousands of Dollars) 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| Modify Sensor/System Dynamic Analyzer. 2/ | 0602204F | | WPAFB, OH, Bldg 23 | | | 100.0 | 200.0 |
| Install Environmental Ctl System For Clean Rooms. 2/ | 0602204F | | WPAFB, OH, Bldg 620 | | | 600.0 | |
| Install Equipment For RASPL Relocation. 2/ | 0602204F | | WPAFB, OH, Bldg 620 | | | | 250.0 |
| Install Metal Organic Molecular Beam Epitaxial System. 2/ | 0602204F | | WPAFB, OH, Bldg 620 | | | 300.0 | |
| Install Equipment for Low Observables. 2/ | 0603003F | | WPAFB, OH Bldg 254 | | | 1,180.0 | |
| | | | B. Test | | | | |
| Test Facility Aerial Hard Targets 1/ | 0604327F | | Eglin AFB, FL | | 1,300.0 | | |
| Test Facility - Const Steel Arch Igloos Ph I 1/ | 0603601F | | UTTR, Utah | | 1,200.0 | | |
| Test Facility - Const Steel Arch Igloos Ph II 1/ | 0603601F | | UTTR, Utah | | | 560.0 | |
| Retrofit/Redesigned Aircraft Shelter Test Article 1/ | 0604617F | | UTTR, Utah | | 4,200.0 | | |
| Test Facility-Reconstruct Concrete Target 1/ | 0604612F/0208030F/ 0604602F | | Eglin AFB, FL | | 463.0 | | |
| | | | C. Prototype | | | | |
| Stationary Neutron Radiography System 1/ | 0708026F | | McClellan AFB, CA | | | 4,150.0 | |

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | Total Obligational Authority (Thousands of Dollars) 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| Equipment Installation for Electrical and Air Conditioning for B-1 1/ | 0604226F | | AFFTC Edwards AFB, CA | | | 1,980.0 | |
| Test Facility - Space Transportation System 1/ | 0604411F | | Vandenberg AFB, CA | | 4,000.0 | | |
| Test Facility - Space Transportation System 1/ | 0305171F | | Vandenberg AFB, CA | | | 4,000.0 | 5,000.0 |
| Locate/Construct Site for Airborne Imagery Transmitter (ARIT) 1/* | 0603727F | | Wright Patterson AFB, OH | | | | 250.0 |
| Install Reconfigurable Electronic Combat Simulator 1/ | 0604738F | | Wright Patterson AFB, OH, Bldg 620 | | | | 1,500.0 |
| Install Combustion Air Heaters & Exhaust System 1/* | 0602203F | | Wright Patterson AFB, OH, Bldg 490 | | | | 300.0 |
| Turbine Research Lab 1/ | 0602203F | | Wright Patterson AFB, OH, Bldg 18C | | | 300.0 | |
| Equipment Installation of CRAY X-MP/48 Computer System 1/ | 0602201F/0602202F/ 0602203F/0602204F | | Wright Patterson AFB, OH | | | 150.0 | 250.0 |
| WIS Development & Evaluation Facility (DEF) Shielded Test Facility 1/ | 0303152F | | Hanscom AFB, MA Bldg 1302F Annex | | 1,700.0 | 640.0 | |
| Fighter Lead-In Trainer 1/ | 0603227F | McDonald Douglas | Williams AFB, AZ | | | | 125.0 |
| Install Electronic Warfare Hot Bench Development Sys. 2/ | 0602204F | | WPAFB, OH, Bldg 620 | | | 500.0 | |
| Install Equipment For Clean Room Support Area. 2/ | 0602204F | | WPAFB, OH, BLdg 620 | | | 400.0 | |

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | 1986 | Total Obligational Authority (Thousands of Dollars) 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| | | | B. Test | | | | |
| Aircraft Shelter Test Article 1/* | 0604617F | | Various | 2,600.0 | | | |
| New Non Destructive Test Facilities | 0304111F | Chemical Systems Division | Cape Canaveral AFS, FL | | 21,800.0 | | |
| | | | C. Prototype | | | | |
| North Warning System (NWS), Unattended Short Range Radar Facility 1/* | 0102412F | | Bar Main Dew Line Station, Barter Island, AK | 9,925.0 | | | |
| | | | D. Temporary | | | | |
| | | | (None) | | | | |

SECTION II

Projects Planned or Projected

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| | | | A. Equipment Installation | | | | |
| Flexible Nozzle Tunnel for 4T (a) 1/ | 0605807F | | AEDC Arnold AFS, TN | | 87.4 | 759.0 | |
| Equipment Installation F-16 Radar and ECCM Testing 1/ | 0207133F | | AFFTC Edwards AFB, CA | 300.0 | 250.0 | 250.0 | |
| Equipment Installation F-15 Avionics Test (IFAST) 1/ | 0207130F | | AFFTC Edwards AFB, CA | 250.0 | 250.0 | 500.0 | |
| Mission Control Center Uninterruptable Power System for Critical Computer Circuits 1/ | | | AFFTC Edwards AFB, CA | | | 600.0 | 150.0 |

| Facility/Equipment* | DT&E Project Number | Contractor | Location | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| | | | | Total Obligational Authority (Thousands of Dollars) | | | |
| Peacekeeper in Minuteman Silos 1/ | Various | Various | Various | 7,900.0 | 4,200.0 | 200.0 | --- |
| Peacekeeper Rail Garrison Basing 1/ | Various | Various | Various | --- | 18,400.0 | 22,000.0 | 13,100.0 |
| Peacekeeper Follow-On Basing Program 1/ | Various | Various | Various | 77,800.0 | 2,200.0 | --- | --- |
| Install Secure TEMPEST Area. 1/ | 0604739F | Industrial Acoustical | Wright Patterson AFB, OH, Bldg 620 | | 900.0 | | |
| Install Electromagnetic Systems Simulator 1/* | 0603109F | Federal Flooring | Wright Patterson AFB, OH, Bldg 620 | | 250.0 | | |
| TAC Implementation 1/* | 0605807F | | Arnold AFS, TN | 499.0 | 437.0 | 450.0 | |
| Test Facility Plant Automation 1/* | 0605807F | | Arnold AFS, TN | 331.0 | 159.0 | 284.0 | 197.0 |
| AEDC Cell C-1 & C-2 Vector/ Reverse Thrust 1/ * | 0604755F | | Arnold AFS, TN | 1,350.0 | 200.0 | | |
| Facility Computer & Network Improvement 1/* | 0605807F | | Arnold AFS, TN | 4,150.0 | 5,500.0 | 3,200.0 | 2,300.0 |
| C-1 Joint Technology Demonstration Engine 1/* | 0604755F | | Arnold AFS, TN | 670.0 | 125.0 | | |
| Upgrade Arc Heater 1/* | 0604755F | | Arnold AFS, TN | 1,430.0 | 1,055.0 | 1,120.0 | 302.0 |
| Equipment Installation Space Transportation System 1/* | 0604411F | | 6595th Shuttle Test Group, Vandenberg AFB, CA | 10,600.0 | | | |
| Full Field of View Dome Display Development 1/* | 558-DDD | | Williams AFB, AZ | | | | 450.0 |

## Part 2. UTILIZATION OF RDT&E APPROPRIATION FOR FACILITIES AT GOVERNMENT-OWNED/GOVERNMENT-OPERATED INSTALLATIONS

DoD Manual 7110-1-M provides that RDT&E appropriations may finance the development, design, purchase and installation (including directly related foundations, shielding environmental control, weather protection, structural adjustments, utilities and access) of equipment or instrumentation required for research, development, test and evaluation activities. Facilities which are consumed in R&D test and evaluation, prototype facilities/equipment, and temporary facilities are also financed as part of the R&D appropriation involved since their intended utility expires when a test is completed. (Note: Contractor-Operated facilities are included in Part 1). The table below provides a summary listing of all such projects for the installation of equipment, where the cost of installation is more than $200,000, accomplished in FY 86 and planned through FY 89.

| Facility/Equipment | RDT&E Project Number | Contractor | Location | Total Obligational Authority (Thousands of Dollars) 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| | | | **SECTION I** | | | | |
| | | | **Projects Accomplished or Underway** | | | | |
| | | | A. Equipment Installation | | | | |
| Test Facility Space Transportation System 1/* | 0604411F | | Vandenberg AFB, CA | 4,900.0 | | | |
| Test Facilities BDCC Evaluation 1/ | 0604711F | | Kirtland AFB, NM | 295.0 | | | |
| Install Class 100 Clean Rooms 1/* | 0602204F | | Wright Patterson AFB, OH | 469.9 | 267.3 | | |
| Modify Gasdynamics Facility 1/* | 0602201F | | Wright Patterson AFB, OH | 68.0 | 50.0 | | |
| Modernize Component Research Air Facility 1/* | 0602203F | | Wright Patterson AFB, OH Bldgs 18B, 18C, and 18E | | 500.0 | | |
| Small ICBM Program 1/ | Various | Various | Various | 2,300.0 | 10,400.0 | 53,300.0 | 53,200.0 |
| Cofferdam Concept Test Program 1/ | Various | Various | Various | 2,000.0 | 6,700.0 | 6,300.0 | --- |

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | Total Obligational Authority (Thousands of Dollars) 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| Solid Rocket Motor Upgrade | 0305119F | (TBD) | Edwards AFB, CA | | | 13,000.0 | |
| Solid Rocket Motor Upgrade | 0305119F | (TBD) | Cape Canaveral AFS, FL | | | 10,000.0 | 4,000.0 |
| Building 1302B 1/* | 0603431F | MIT Lincoln Laboratory | Hanscom AFB, MA | | 1,286.0 | | |
| Extension to L-Band Transmitter High-Bay Area 1/* | 0102424F | MIT Lincoln Laboratory | Millstone Hill Westford, MA | | | 405.0 | |
| Compact Antenna Range 1/* | 0603311F | MIT Lincoln Laboratory | Hanscom AFB, MA | | | 1,820.0 | |
| Computer Test Lab 1/ | 0102424F | MIT Lincoln Laboratory | Millstone Hill Westford, MA | | | 910.0 | |

(1) 1,000.0K SDI funds added for total project cost of 2,586.2K.
(2) 1,191.0K SDI funds added for total project cost of 1,787.0K.
(3) 2450.0K SDI funds added for total project cost of 545.0K.

SECTION II

Projects Planned or Projected

| Facility/Equipment* | RDT&E Project Number | Contractor | Location | Total Obligational Authority (Thousands of Dollars) 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|
| Medium Launch Vehicle Program 1/ | 0305119F | (TBD) | Cape Canaveral AFS, FL | | | 1,500.0 | 9,000.0 |
| AFSTC/OL-AA, Malabar FL Malabar Advanced Telescope System 1/* | 0604710F | ITEK Corp | Malabar Test Annex (ESMC) Malabar FL | | 800.0 | | |
| Titan IV Facilities 1/ | 0305119F | Martin Marietta | Vandenberg AFB, CA | | 70,000.0 | | |
| Building 1302J-Addition to Electronic Research Lab 1/* | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | 2,450.0 | | |
| Building 1302M-Addition to Chemical Stock Facility 1/ | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | | 294.0 | |
| Building 1302V-Addition to Electronic Research Lab 1/ | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | | 1,925.0 | |
| Building 1312L-Addition to Electronic Research Lab 1/ | 0102424F | MIT Lincoln Laboratory | Hanscom AFB, MA | | | 596.0 (2) | |
| Building 1302E-Addition to Electronic Research Lab 1/ | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | | 909.0 | |
| Building 1302D-Addition to Electronic Research Lab 1/ | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | 517.0 | | |
| Building 1302C-Addition to Electronic Research Lab 1/* | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | 295.0 (3) | | |
| Building 1302E-Addition to Electronic Research Lab 1/ | 0603250F | MIT Lincoln Laboratory | Hanscom AFB, MA | | | 1,565.0 | |

## MAJOR IMPROVEMENTS TO AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES

### FUNDED BY RDT&E

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| SUBTOTAL PART 1 | 21,158.6 | 99,168.0 | 44,024.0 | 20,100.0 |
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